August 7, 1961

CHEMICAL ENGINEERING

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AUG 10
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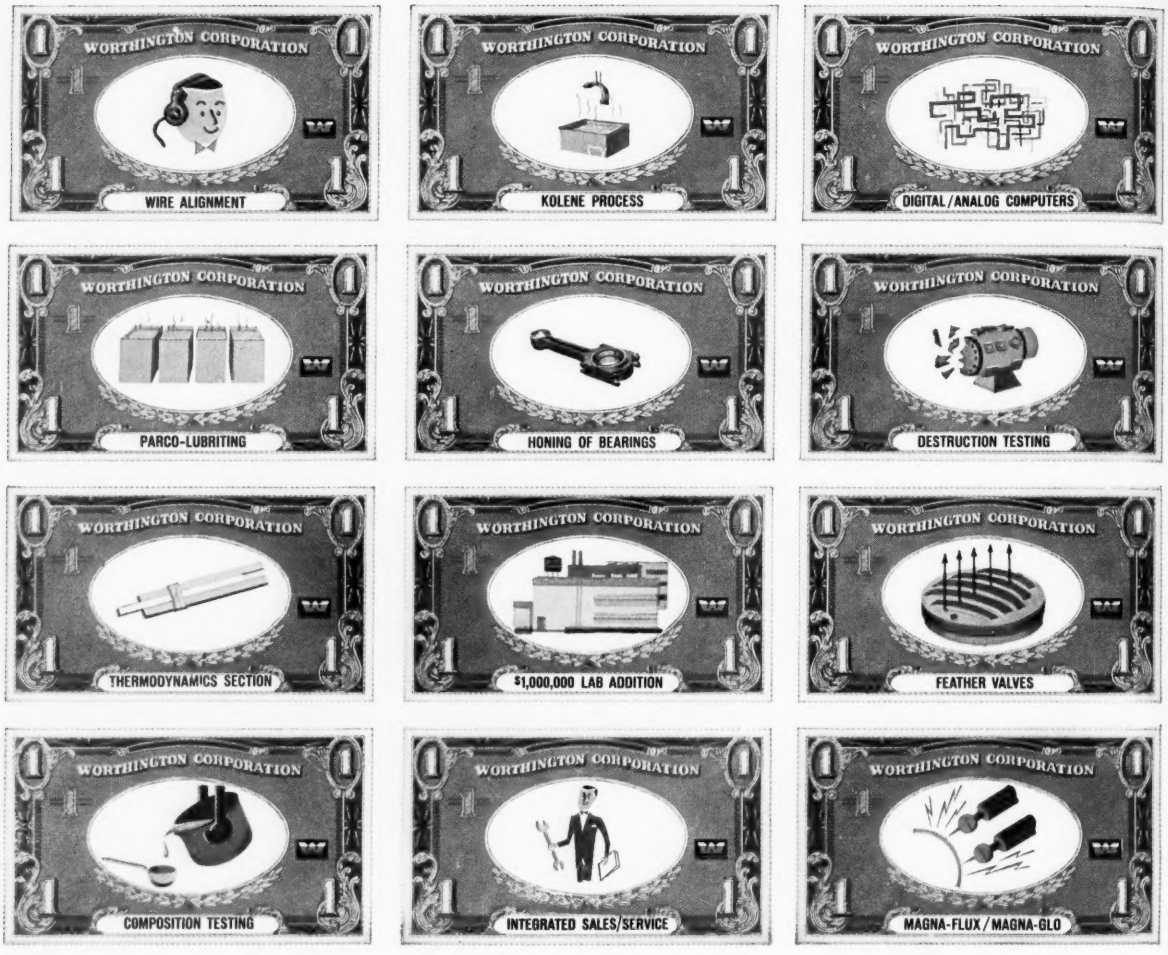
Also in this issue:

... disaster ...

COMPRESSOR DOLLARS



WHAT'S IN THE PRICE?

These are dollars that are paid out every day for Worthington compressors. They reveal a few of the extra or "hidden values" that make the compressors worth most for the dollars invested. But even more important, they give a clue about real compressor values.

Today, rising costs and minimum profits compel every buyer to scrutinize compressor dollars more closely—to make sure they contain a full measure of value. In fact, your problem in determining the true value of a quotation is more difficult —but more important—than ever before.

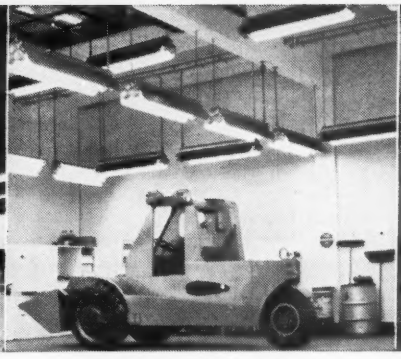
What do we suggest? You must, of course, evaluate the price—dig for the "hidden values" buried in each manufacturer's offering with increased diligence. You can be sure that the values of prices will separate very quickly, because "hidden values" vary sharply in the compressor market today.

To help you isolate and evaluate competitive compressor offerings, we have prepared an objective "Compressor Evaluation Guide." This booklet points out the six key areas of judgment required for compressor evaluation and details them in full. Ask your Worthington Representative for this booklet or write Worthington Corporation, Dept. 36-18, Clinton Street and Roberts Avenue, Buffalo, N. Y. In Canada, Worthington (Canada) Ltd., Brantford, Ontario.

WORTHINGTON

PRODUCTS THAT WORK FOR YOUR PROFIT

"EFU" Explosion-Proof Fixtures Give Safe, Bright Illumination in Paint Plants . . .



Dependable, Trouble-Free Service in Hazardous Area Paint Shops . . .

Modern, 45° Angle Mount in Garage Pits . . . or Wherever Safe Lighting is Required

For Hazardous Area Lighting You Can Rely On...

APPLETON®

"EFU" Explosion-Proof Fluorescent Fixtures

Type "EFU" 2-Lamp Fixture 45° Angle Mounted and Suspended From Type "ESS" Swivel Mounted On "GRFC" Flanged Outlet With Canopy

Pat. No. 2,392,202 and Pat. Pending

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Quality built in every detail, APPLETON "EFU" fixtures are prefectly designed and carefully constructed by experienced craftsmen. Factory sealing eliminates the need for external seals. In addition, all models have cast aluminum end housings containing terminal blocks where line connections are made, and aluminum threaded covers to protect line connections, starters and lamps from hazardous fumes, dirt or dust. All lamps are protected and totally enclosed by heavy Pyrex glass tubes. APPLETON "EFU" fluorescent fixtures are U.L. and C.S.A. approved and meet specifications of Article 500 of the National Electric Code.

Sold Through Franchised Distributors Only

- **Choice of 33 different models (see chart below)**
- **Available in 2, 3, or 4 lamp styles**
- **Choice of horizontal or 45° mounting**
- **Steel reflectors . . . white enameled inside, grey outside**
- **Relamping from either end**
- **"Rapid Start" ballast where desired**
- **Streamlined design, totally enclosed yet easily accessible**
- **Application layouts furnished by APPLETON upon receipt of installation data**

"EFU" Fixtures Available As Indicated By •

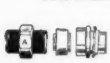
Circuit Voltage 60 Cycle	40 WATT, 48 INCH T-12			100 WATT, 60 INCH T-17—BI-PIN		No. Lamps
	Bi-Pin		Single-Pin Instant-Start Slimline			
	Pre-Heat	Rapid-Start		Pre-Heat	Rapid-Start	
110—125	•	•	•	•		2
	•	•	•	•		3
	•	•	•	•		4
199—216	•					2
	•					4
220—250	•	•	•			2
	•					3
	•	•	•	•	•	4
250—290	•	•	•	•		2
	•	•	•	•		3
	•	•	•	•	•	4

APPLETON Electric Company

1701 Wellington Ave. • Chicago 13, Illinois

Also Manufacturers of:

Malleable Iron Unilets & Covers



"ST" Series Connectors

"Eagle Claw" Switch Boxes

Reelites

to keep you from getting the wrong answer to your solid-liquid separation problem

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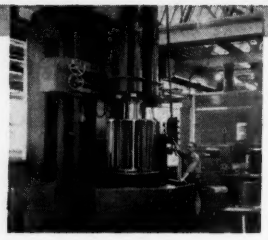
Invests millions of dollars.....



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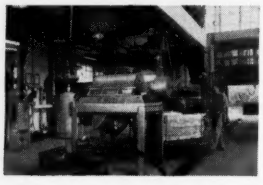
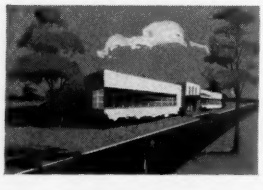
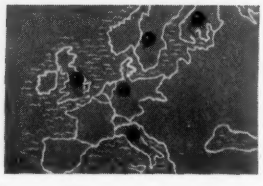


In comprehensive testing facilities

In research and development



In application engineering offices located in your vicinity



In world wide relationships with leading equipment designers and builders.

what's more,

BIRD *builds all types:*

Bird Continuous Solid Bowl Centrifugals
Bird Continuous Screen Centrifugals
Bird-Young Drum Type Vacuum Filters
Bird-Prayon Horizontal, Pan Type Vacuum Filters
Bird Horizontal Tank, Vertical Pressure Leaf Filters
Bird Suspended Batch Centrifugals
Bird Continuous Centrifugal Classifiers

Recommendations are therefore unrestricted and unprejudiced. The machine is fitted to the job — not the job to the machine.

BIRD MACHINE COMPANY

SOUTH WALPOLE, MASSACHUSETTS

BUILDERS OF THE COMPLETE LINE OF SOLID-LIQUID SEPARATING EQUIPMENT

Operators of the **Bird Research and Development Center** for pilot-scale testing to determine the correct equipment for the job. Yours to use.

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CHEMICAL ENGINEERING

August 7, 1961

CHEMICAL TECHNOLOGY FOR PROFIT-MINDED ENGINEERS

COVER PHOTO: View through peephole into Selas Corp.'s catalytic steam reforming furnace at Gulf Oil Corp.'s new oxo-alcohol plant in Philadelphia. Radiant burners heat tubes to two different temperature levels for generating synthesis gas and hydrogen. For a story on the growing importance of hydrogen, see p. 62.

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Where skillful hands work for you

Craftsmanship follows through on every stage of the design and fabrication of pressure vessels and heat exchangers at Downingtown Iron Works. Come and see for yourself. Inspect our shop procedures on work in normal progress. Or write for helpful Bulletins HE and CI.

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CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

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highlights of this issue

PLAN IN ADVANCE FOR DISASTER CONTROL

Stardust Chemical Co. is in trouble again, this time because of a series of fires and explosions whose effects were greatly magnified by lack of planning for disaster control. Conducting a serious post mortem on this fictitious disaster is a panel of real experts, whose discussion at a recent meeting of National Institute for Disaster Mobilization we recorded, transcribed and edited as our Feature Report (p. 111).

UPS AND DOWNS OF THE JOB MARKET

Is the job market bullish or bearish? The new Deutsch & Shea "engineer/scientist demand index" (p. 140) might provide the answer, aiding employers and employees alike in that all-important business of matching available professional talent to available job openings.

HYDROGEN CONSUMPTION HITS NEW HEIGHTS

Despite an excess of available hydrogen in the U. S., chemical producers and petroleum refiners find themselves lacking enough H_2 of the right purity and in the right places. Assistant Editor Fred Price's review of this situation (p. 62) analyzes growing demands for hydrogen and the likely sources that will fill these demands.

TEFLON LINER REPAIRS CORRODED PIPE

Here's an unusual "failure" story—and how smart engineering turned it into a success story. In a Corrosion Forum feature (p. 156), GE engineer Campbell and metallurgist Kingsley describe how the Hanford Atomic Products plant remedied the stress-corrosion failure of a concrete-embedded steam pipe by use of a Teflon liner.

A QO® CHEMICALS BULLETIN

Some solvents have high boiling points

Other solvents have complete water miscibility

BUT

QO® TETRAHYDROFURFURYL ALCOHOL HAS BOTH— PLUS A NEW LOW PRICE

The high boiling point (178°F.) of tetrahydrofurfuryl alcohol (THFA®) combined with its complete water miscibility gives a means of carrying out reactions with water soluble materials at temperatures not otherwise practical.

These unique characteristics of THFA may be reason enough for your consideration of this primary alcohol, but in addition, it is an excellent solvent in its own right. Many complex organic substances such as dyes, resins, lacquers and coating compositions that are not soluble in common solvents readily go into solution in THFA. In addition, THFA has a high flash point, low viscosity, low toxicity and a light color which are extra assets.

Quaker Oats lowered the price of this alcohol in April, 1961 to 25¢/pound in tank car quantities East of Denver, Colorado. As the market expands and important new uses develop, additional savings may be possible. So, if you have a potential application for this unique solvent, now is the time to make an evaluation.

Write for your copy of Bulletin 206-A on THFA which describes its physical properties, chemistry, and applications and for a copy of the new price list.

The Quaker Oats Company

CHEMICALS DIVISION

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Pro: Houdry Isoprene Process

Sir:

We read with considerable interest the article on isoprene in your May 29 issue (pp. 42-4).

The comparison of processes on p. 44 makes misleading statements concerning Houdry's process for isoprene. You imply that our process is still in the laboratory stage, that high temperatures are detrimental, that accompanying production of piperylene is a drawback because "no use has yet been found"; you state categorically that catalyst life is short.

Actually, the Houdry process is a simple extension of the widely used commercial Houdry dehydrogenation process for production of butadiene. Catalyst life in the order of a year is hardly "short," and whether temperature is "high" or not is only relative and not necessarily detrimental. Maybe no large-scale uses of piperylene exist simply because this chemical has not been available in large quantities.

H. A. SHABAKER
Houdry Process Corp.
Philadelphia, Pa.

Con: Hoeppel Trade Plan

Sir:

J. H. Hoeppel's plan ("Pro Trade, Con Aid," June 26, p. 7), by eliminating tariffs now protecting many American industries, would result in such chaotic conditions—immediate increase in unemployment and loss of capital investments—as to be quite impractical.

Furthermore, his idea of an international dollar is no different from what Germany did, prior to World War II, with the Askimark. If American goods were attractive, price and quality-wise, there would be no unfavorable trade balance, as the dollars spent abroad would readily be redeemed in merchandise and not in gold.

As was the case with the Askimark, the foreign holder of international dollars (assuming that he were not also an importer) would have to dispose of same, and buyers would be interested only if they could secure such dollars at a rate of exchange which would make American merchandise attractive from a cost standpoint.

In other words, the international dollar would be discounted and, as its value went down (as again was the case with the Askimark), the foreign exporter to the U. S. would have to raise his prices to us. In due course, this would mean that foreign goods could no longer compete with those made in this country, but that we would be paying through the nose for things in which we are not self-sufficient.

S. GYSIN
Bell Oil & Foreign Corp.
Newark, N. J.

Sir:

Mr. Hoeppel seems almost entirely unaware of the realities of world trade.

• The U. S. has for many years exported more goods than it imported. Our adverse trade balance is caused by overseas business investment to some extent, but mainly by military aid to other countries. Mr. Hoeppel's idea would therefore restrict our trade.

• Our trade has held up quite well, and we have today a slightly larger share of world trade than we had in 1938. The difficulty has rested with our inability to improve our productivity; we have evidently preferred to spend our most advanced technical thinking on armaments.

• The currency finagling Mr. Hoeppel suggests is by no means new. One Adolf Hitler used this approach with his "export marks," and so have quite a number of other economic cave-dwellers.

CE did not display much sophistication when it took Mr. Hoeppel's

continued on page 184

CE author threatens CE editor—all in fun

USE ZONE NOS. FOR BETTER SERVICE
Mr Herbert Popper
This is Popper. There's a man out here with a shot-gun. Name 7 Loc. Shall I send him in?
CHEMICAL ENGINEERING
McGraw Hill Pub. Co.
330 W. 42nd St.
New York 36
N.Y.

This is a reproduction of the actual envelope bearing a recent communication from one of CHEMICAL ENGINEERING'S *most valued friends and contributors, Chesman A. Lee. It was his novel way of registering disapproval of the way the byline appeared with his article on closed-circuit grinding in our May 29 issue (pp. 112-4). Commented Mr. Lee in his letter:*

"You did a good job in editing the article, but why make it appear that the U. S. Steel Corp. is grinding cracklings for protein meal? Would it be in order to mention in your letters column that this article was based on previous experience?"

So be it. Mr. Lee's article was based on previous experience, which has been long, varied and productive of ideas for CE readers over the years.

NEW CHIKSAN SPRING BALANCED LOADING ARM–

Self compensating spring tension provides complete balance at any position, regardless of position of outer leg. Tension is adjustable if required.

Steel arm is built to take constant use and handling. Top quality components and fabrication mean years of trouble-free service.

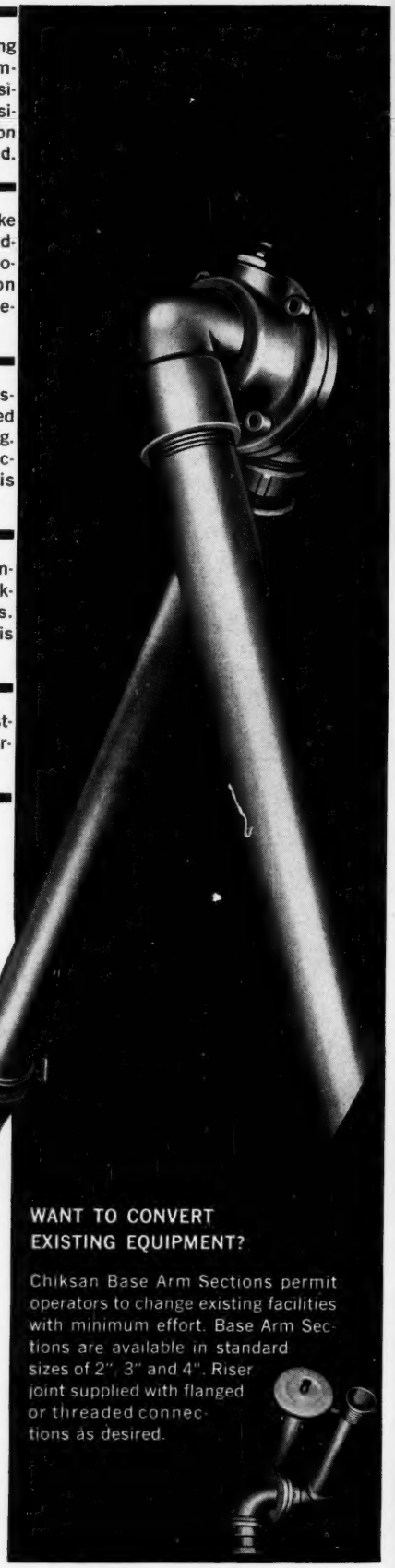
Compression spring assembly is fully contained in strong steel housing. Disassembly for inspection and servicing is readily accomplished.

Compact design. No dangerous protruding brackets or counterweights. Catwalk behind arm is free of obstructions.

Full pre-set stop adjustment at any angle in vertical plane.

FEATURING THE REMARKABLE TOTALLY ENCLOSED COMPRESSION SPRING DESIGN

The Chiksan Spring Balanced arm can be readily installed in any existing terminal. Also, the arm can be modified in the field when more length or equipment is added to it, by the addition of more springs.

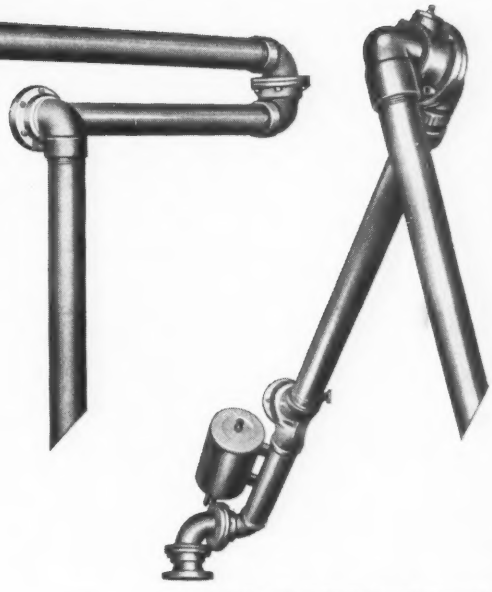


WANT TO CONVERT EXISTING EQUIPMENT?

Chiksan Base Arm Sections permit operators to change existing facilities with minimum effort. Base Arm Sections are available in standard sizes of 2", 3" and 4". Riser joint supplied with flanged or threaded connections as desired.

FOLDED ARM MODEL-DS

Standard Sizes: 2", 3", 4". This quality, heavy-duty arm for hard-to-handle chemicals features the versatile DS Series Swivel Joint described below. The swivel joint combination allows for reach to any point within working range from a minimum of 3-feet from riser pipe to a maximum of 11-feet in the two and three-inch arm and 9-feet in the four-inch arm.



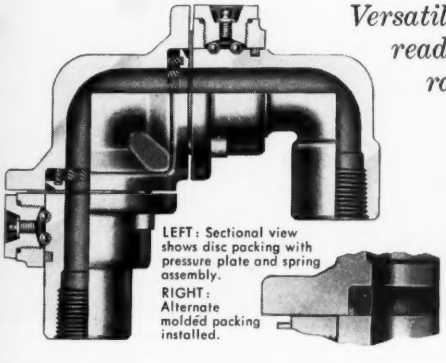
SLIDING SLEEVE MODEL-DS

Standard Sizes: 2", 3", 4". The sliding sleeve Chiksan arm for chemical service employs two DS swivel joints, one on the riser, the other at the drop pipe. The sliding sleeve is of aluminum and bronze construction with an asbestos seal. (Viton and teflon seals are also available.)

EFFECT FAST, SAFE HANDLING OF CHEMICALS AT YOUR LOADING TERMINALS

FOR TRUCK OR TANK CAR LOADING—

Here's a series of loading arms that measures up on every count. Check payout time. The Chiksan chemical service arms score excellent on minimum maintenance and long service life with little replacement attention. Check operating ease. There's finger-weight flexibility and the arm stays put during adjustment—doesn't creep or sag. Check versatility. With the DS series swivel joint you can, with proper packing, handle virtually any chemical your plant processes or ships. And when it comes to safety, the Chiksan chemical service loading arm has an unbeatable record. Get the facts. Write Chiksan for Bulletin 1-61.



LEFT: Sectional view shows disc packing with pressure plate and spring assembly.
RIGHT: Alternate molded packing installed.

Versatile DS Series Swivel Joint readily adapted to a wide range of services...

There is a Chiksan packing type and compound for handling nearly every chemical in commercial use, also steam and hot gas as well. Further, the DS Series Joint permits packing replacement without removal of ball bearings.

HANDLING PETROLEUM PRODUCTS?

For petroleum service, Chiksan offers you a complete line of spring balanced arms. Choose between the Folded Arm (shown above) or a Sliding Sleeve. Long Reach and Bottom Loader models too. Bulletin 1-61 contains full descriptions. Send for your copy now.

FOR COMPLETE INFORMATION MAIL COUPON TODAY

CHIKSAN COMPANY, 330 North Brea Blvd., Brea, California

Please send me copy of Bulletin No. 1-61.

Name _____

Company _____ Title _____

Address _____

City _____ Zone _____ State _____

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61-62

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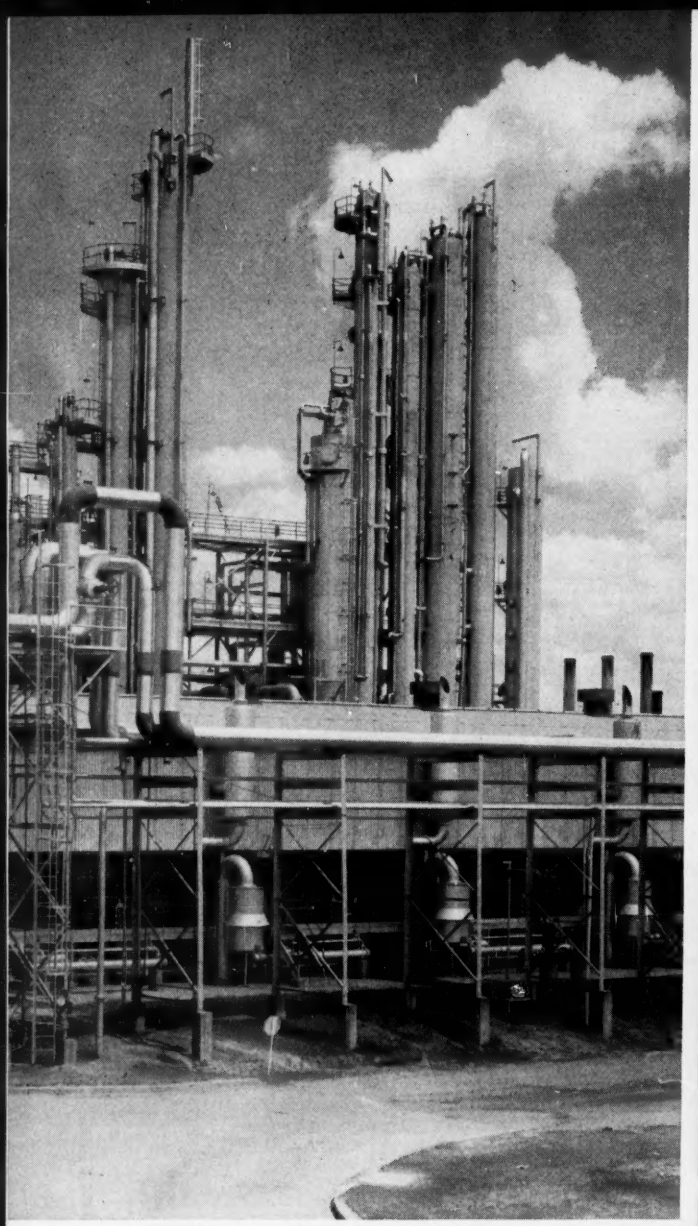
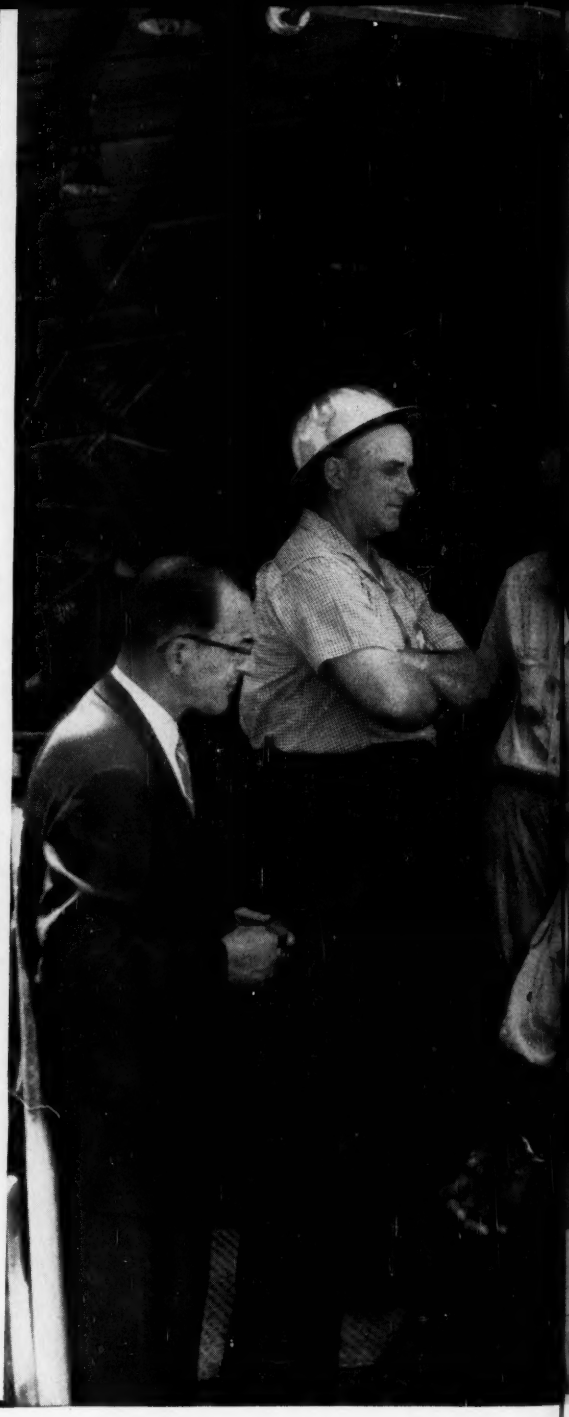


Hydrocarbon cracking plant produces ethylene and propylene for polyethylene and polypropylene plastics, ethyl alcohol and aldehydes. Compressor building in foreground houses 5 Cooper-Bessemer GMV compressors. In an adjacent building are 5 GMVA units.

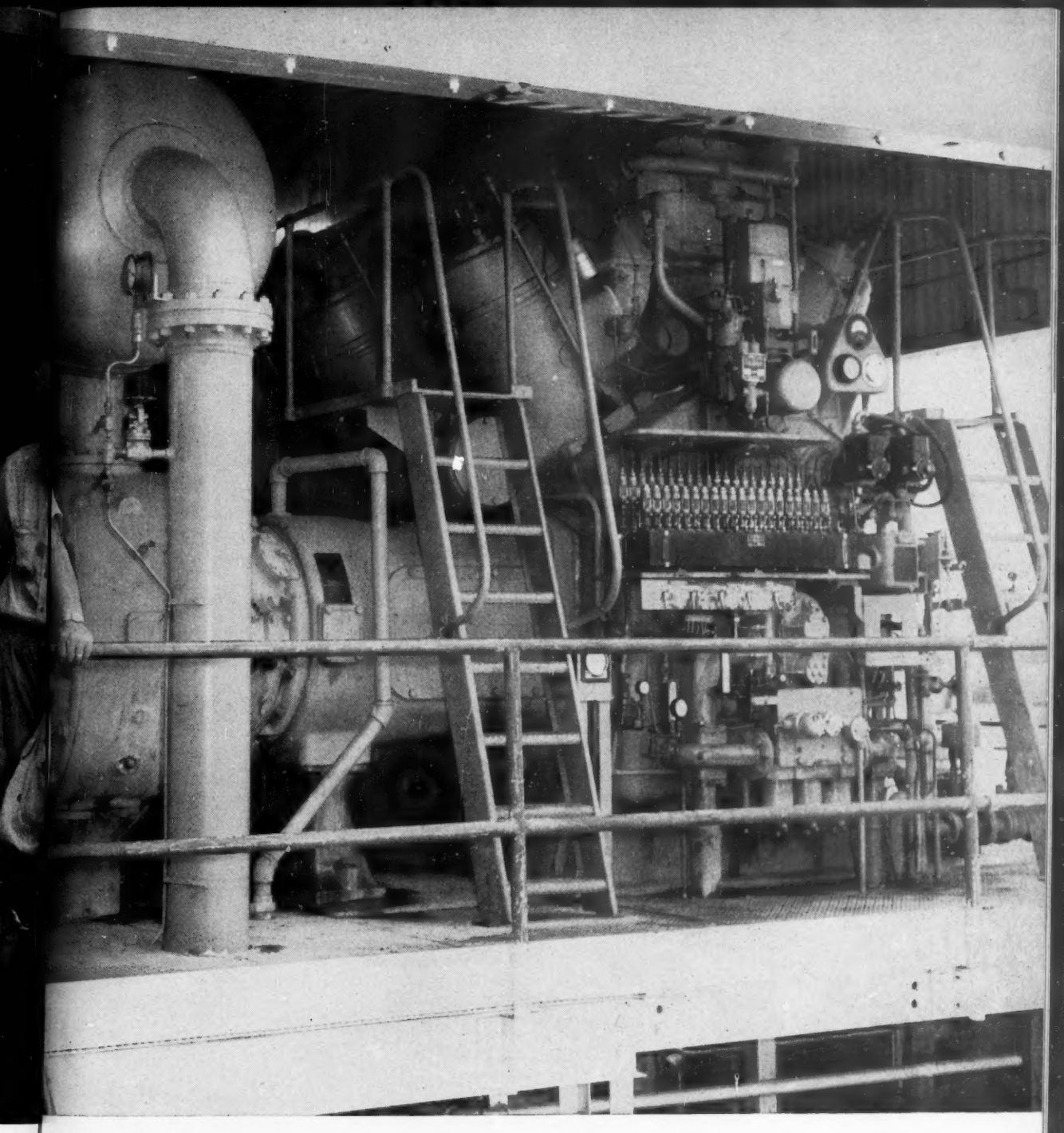
Discussing conversion of several 1350 hp GMVA-10 compressors to series turbo-charging for greater fuel economy . . . Foreground, left to right: C. W. Woltz, Manager of C-B's Shreveport office; E. R. McWhorter, Ass't. Superintendent of Texas Eastman's cracking plant. Background: Nelson Barksdale, Maintenance Supervisor of Texas Eastman's cracking plant; Joe E. Geurin, Service Engineer of C-B's Shreveport office.



How Cooper-Bessemer on-the-spot service helps Texas Eastman

Since their beginning in 1950, Texas Eastman production facilities in Longview, Texas, have been continuously expanded and improved. And, from the start of this program of progress, Cooper-Bessemer equipment and service have played an important part.

Cooper-Bessemer gas engine compressors have vital roles in this vast group of processing plants. Today, 32 of these units are in service, most of them 'round the clock.



The performance of this C-B equipment is backed up at all times by Cooper-Bessemer *on-the-spot service* . . . nearby application engineers, service engineers and spare parts warehouses . . . to assure reliability and to incorporate the latest C-B advancements in Texas Eastman facilities.

Call our nearest office for assistance in planning *your* compression and power facilities.

BRANCH OFFICES: Grove City • New York • Washington • Gloucester • Pittsburgh Mount Vernon • Detroit • Chicago • Minneapolis • St. Louis • Kansas City • Tulsa New Orleans • Shreveport • Houston • Greggton • Dallas • Odessa • Pampa • Casper • Seattle San Francisco • Los Angeles

SUBSIDIARIES AND DIVISIONS: Cooper-Bessemer International . . . New York
Cooper-Bessemer, S.A. . . . Chur, Switzerland • The Hague, Netherlands • Mexico City Buenos Aires, Argentina • Anaco, Venezuela • Caracas, Venezuela • San Juan, Puerto Rico
Cooper-Bessemer of Canada, Ltd. . . . Edmonton • Calgary • Toronto • Halifax • Stratford
The Rotor Tool Company . . . Cleveland
C-B Southern . . . Houston
The Kline Manufacturing Company . . . Galena

Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

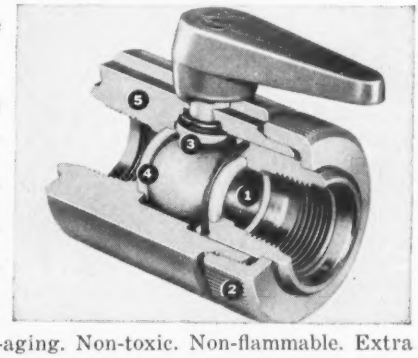
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINES: GAS · DIESEL · GAS-DIESEL
JET-POWERED GAS TURBINES

NEW...
WALWORTH PVC BALL VALVE

...WITH REALLY LONG LIFE BUILT IN

Here's the ball valve that beats them all on longevity—the Walworth Polyvinyl Chloride Ball Valve. With its super-rugged construction, this valve is on the line to stay! □ When you handle tough, corrosive fluids, and want fast, tight shut-off get Walworth PVC Ball Valves. Your Walworth distributor can recommend from the most complete line of PVC Valves and fittings available today.

■ *Only Walworth offers all these long life features in a PVC Ball Valve:* **1. Full port opening.** Ball port is same nominal I.D. of the pipe itself. Full flow. Minimum turbulence. **2. Single-end, external adjustment.** Holds operating torque to the minimum. Ball rotates at a fixed location. Maintains alignment. **3. Rugged stem-to-ball construction.** Assures quick, positive shut-off every time. Built to last through 250,000 cycles ...equivalent of *80 years* of normal service! **4. Teflon seat rings.** Fully supported to provide leak-proof seating. High corrosion resistance. **5. Type I normal impact PVC.** Corrosion-resistant, non-aging. Non-toxic. Non-flammable. Extra rugged construction. Write for bulletin 196. • Walworth Co., 750 Third Ave., N. Y. 17, N. Y.



WALWORTH

The Walworth Companies: Alloy Steel Products Company • Conoflow Corporation • Grove Valve and Regulator Company • M & H Valve and Fittings Company • Southwest Fabricating & Welding Co., Inc.

LIME

SILICATE PIGMENT

POLYVINYL CHLORIDE

SODIUM CHROMATE

SODIUM BICARBONATE

DICALCIUM PHOSPHATE

CITRIC ACID

POTASSIUM CARBONATE

BARIUM OXIDE

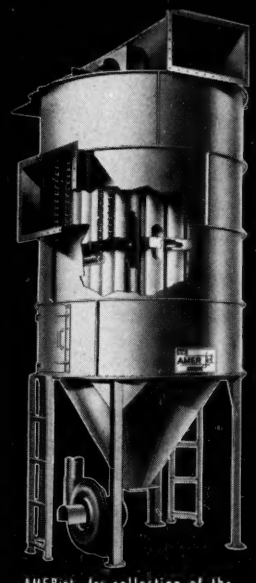
SODIUM FORMATE

BORIC POWDER

AMMONIUM NITRATE

ALUMINA HYDRATE

CARBON DUST



AMERjet—for collection of the very finest particles and particles that must be recovered dry.

CRYSTALLINE D

PHOSPHATE DUST

LEAD OXIDE

STARCH D

TITANIUM DIOXI

ALUMINUM OXIDE

PIGMENTS

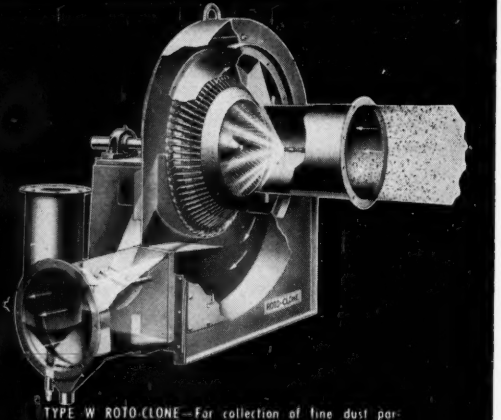
CAUSTIC VAPO

CARBON DUST

LEAD STEARATE

CLAY

BARIUM SUL



TYPE W ROTO-CLONE—For collection of fine dust particles in moderate concentrations.

TRIPLE TROUBLE

CUPRIC OXIDE

CALCIUM SULFATE

ALUMINA

CARBON BLACK

INSECTICIDES

AZO DYE

VOLCANIC ASH

FUNGICIDE POWDER

FERTILIZER DUST

GLYCERIN VAPOR

PLASTICS

HERMICULITE DUST

LIME

ALUMINUM POWDER

PHOSPHATES

BARIUM CARBONATE

TYPE N ROTO-CLONE—For collection of heavy dust loadings of all particle sizes.

SULPHURIC ACID MIST

ZINC STEARAT

SODIUM CITRATE

BARIUM SULFATE

ALUMINUM SILICATE

T.N.T.

SODIUM SILICAT

AMMONIUM SULFATE

METALLIC OXID

BAUXITE

PIGM

PHENOLIC RESINS

FOR DUST!

THESE AAF UNITS DO MANY JOBS FOR CHEMICAL PROCESSORS

The materials at left are but a smattering of the hundreds being efficiently and economically collected for the chemical industry by AAF's AMERjet and wet-collecting ROTO-CLONES.

All three units offer these four basic design features: (1) small space requirements, (2) maintained performance over a wide range of operating conditions, (3) constant exhaust volume, and (4) high collection efficiency.

For more complete information on any or all of these units, call your local AAF representative or write direct for Type W Bulletin 272B; Type N Bulletin 277; AMERjet Bulletin 279. Address Mr. Robert Moore, American Air Filter Company, Inc., 326 Central Ave., Louisville, Kentucky.

AAF **American Air Filter**

BETTER AIR IS OUR BUSINESS

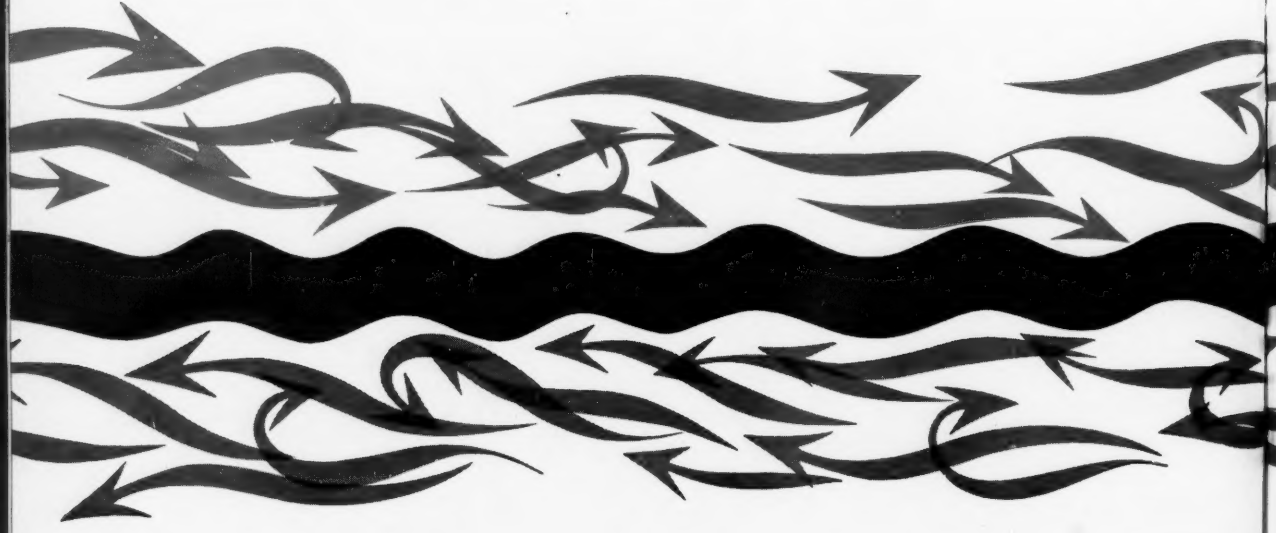
Turbulent liquid layers give remarkable heat transfer in DE LAVAL PLATE HEAT EXCHANGERS

In the past five years, plate heat exchangers hav
been rapidly outgrowing the limitations of earlie
"special" all-stainless applications to become a com
mon replacement for shell and tube units. Extrem
compactness, high transfer efficiency, flexibility an
trouble-free maintenance have justified this wide
ing use. Installation requires only piping connection

The benefits of De Laval Plate Heat Exchange
are highlighted here—but you will want to revie
our "case history" brochure detailing actual proces
ing applications. Write for it, and for our catal
which describes models ranging from 500 to 500,0
lbs/hr capacity.

3 DEGREES OF ECONOMY
open new process possibilities

When the equipment must be all-stainles
At as little as one-third of the cost, including install
tion, De Laval PHE's do the job better than stainle
shell and tubes. Most important, these lower cos
and higher efficiencies now permit heat recover



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where the cost of stainless shell and tube exchangers previously made it impractical.

When partial-stainless is required: The *all* stainless De Laval PHE is almost always cheaper on an installed cost basis than stainless tubes in a steel shell—and offers many operating and maintenance benefits.

When carbon-steel is satisfactory: Even here, De Laval's all-stainless PHE's can return the higher unit cost through much cheaper installation and through annual savings because of their relative freedom from fouling and easier cleaning. Because they are free from corrosion problems and can be easily adapted or expanded to suit changing product needs, De Laval Plate Heat Exchangers are the *safe* way to handle *any* process heat exchange problem.

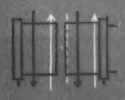
THE DE LAVAL SEPARATOR COMPANY

oughkeepsie, N. Y.
724 N. Pulaski, Chicago 46, Ill.
01 E. Millbrae Ave., Millbrae, Cal.
ept. CE-8

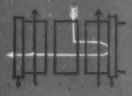
DE LAVAL

Remarkably compact, the De Laval Plate Heat Exchanger is a series of gasketed corrugated stainless steel plates which are "programmed" for each specific application.

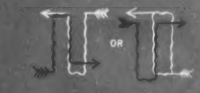
One unit can be compartmented into two or more independent heat exchangers by inserting "connecting" plates.



The component sections can also provide complete regenerative heating and cooling cycles in a continuous flow pattern.



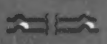
There is great flexibility in design. Plates can be easily positioned for flow patterns that permit a wide range of coolant/product ratios.



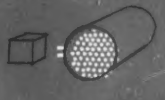
De Laval PHE's are designed for expansion. As the need grows, more exchange capacity is easily and cheaply added.

De Laval Plates are corrugated to provide maximum exchange turbulence—even at Reynolds numbers in the 200 range. This is why De Laval Plate Heat Exchangers, area for area, average three times the exchange capacity of tubes.

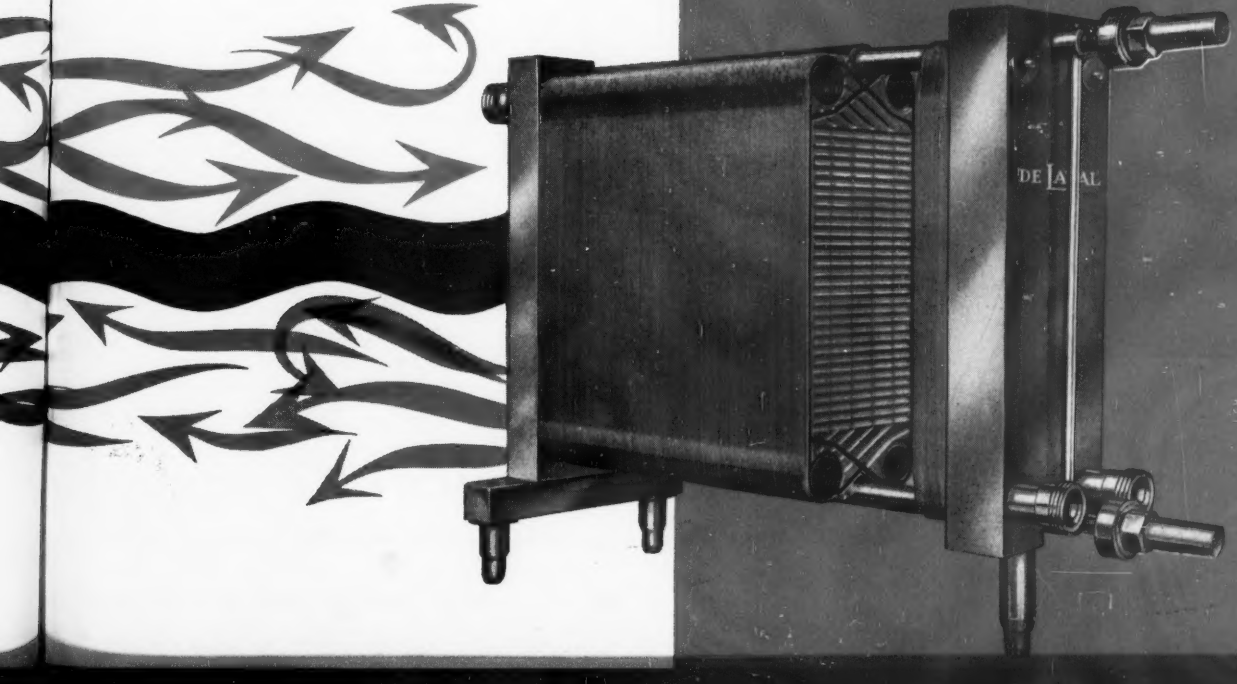
Inert gaskets are recessed in strengthening grooves and withstand pressures to 340 psi and temperatures to 300°F.



Heat transfer coefficients average 600-800 Btu/Hr°F. ft² and often run to 1000! Coupled with the compact physical design, this means one cubic foot of De Laval plate pack is equal to 4 cubic feet of a typical shell and tube type in providing equivalent heat exchange.



Cleaning of the smooth stainless steel surfaces, if required at all, can very often be done "in place" by reverse flushing with a cleaning solution because of the scrubbing effect of the turbulent flow action. But when used with products that have a natural tendency for fouling, the pack opens in minutes for inspection and cleaning.



a bit of ARMOFLO here...

ARMOUR IDEA CHEMICALS

A pound, or less, of Armoflo® compound will condition a ton of various hard-to-handle dry materials. Applied at an appropriate stage in processing, these liquid conditioners assure free flow of the product in process, function as anti-caking and anti-dusting agents during subsequent handling and storage.

Armoflo compounds may be applied as received, by spraying, dripping or fogging onto the product while it is tumbling in rolling or blending equipment. Armoflos coat each particle with a monomolecular layer that changes hygroscopic surfaces to hydrophobic. They will withstand product heats up to 325° F. and are stable in storage for long periods. Armoflo compounds also provide virtually complete corrosion inhibition for iron and steel processing equipment.

A smoother, faster, more even flow of product results when Armoflos reduce friction between particle surfaces. This lubricating action reduces abrasion and thus reduces "fines" and dust formation.

Armoflos are now being used commercially with a number of products and current testing indicates many more potential applications. The versatility of Armoflo compounds is demonstrated by the following three categories of materials.

FERTILIZERS

Armoflo compounds are effective conditioners for all types of mixed fertilizers —low as well as high analysis grades. The compounds act as anti-dusters on low analysis grades and as anti-dusters and/or anti-cakers in high analysis grades. Armoflos are being used effectively as anti-dusting and anti-caking agents on these typical grades:

Anti-caking and Anti-dusting of High Analysis Grades	Anti-dusting of Low Analysis Grades
0-20-20	0-20-0
5-10-5	3-12-12
5-20-20	3-9-18
7-21-21	3-9-27
7-28-14	4-12-8
10-10-10	4-12-12
12-12-12	5-40-0
15-15-15	8-8-8
17-7-0	10-6-4

Armour Industrial Chemical Company

One of the Armour Chemical Industries • 110 North Wacker Drive, Chicago 6, Illinois

DOES A BIG JOB HERE

SINGLE FERTILIZER SALTS

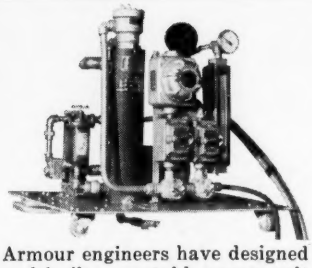
Many of the salts used in formulating mixed fertilizers are hygroscopic and must be conditioned to prevent caking. Armoflo compounds successfully inhibit caking, improve product flow and reduce dust resulting from abrasion. Typical of such Armoflo applications are:

- Ammonium chloride
- Ammonium sulfate
- Diammonium phosphate (21-53-0 and 16-48-0)
- Manure salts
- Monoammonium phosphate
- Nitrate of lime
- Potassium chloride
- Potassium nitrate
- Potassium sulfate
- Sodium nitrate
- Urea (prill & crystal)

OTHER MATERIALS

Armoflo compounds likewise do an effective job of helping prevent caking and dusting of various inorganic and organic materials. They function well across a wide pH range from acidic to highly alkaline. The materials listed below, as well as similar products, can be successfully conditioned.

- Caustic Soda
- Detergents
- Dextrin-urea blends
- Fluorspar
- Glues (mixed, powdered)
- Guar gums
- Hypochlorites
- Insecticides
- Magnesium oxide
- Metallic soaps
- Pentachlorophenol
- Rock salt
- Sodium bisulfate
- Sodium chlorate
- Sodium metasilicate
- Sulfur
- Sylvite
- Thermosetting plastics
- Zinc chloride



Armour engineers have designed and built a portable spray unit which demonstrates the effectiveness of Armoflo compounds in the most practical way—right in your plant. This self-contained unit permits conditioner application at several different points of product processing.

ARMOUR IDEA CHEMICALS

Armour Industrial Chemical Company
110 N. Wacker Drive • Chicago 6, Ill.

Please send me:

☐ a copy of your new, revised edition of "ARMOFLO—Armour Anti-dusting and Anti-caking Chemicals."

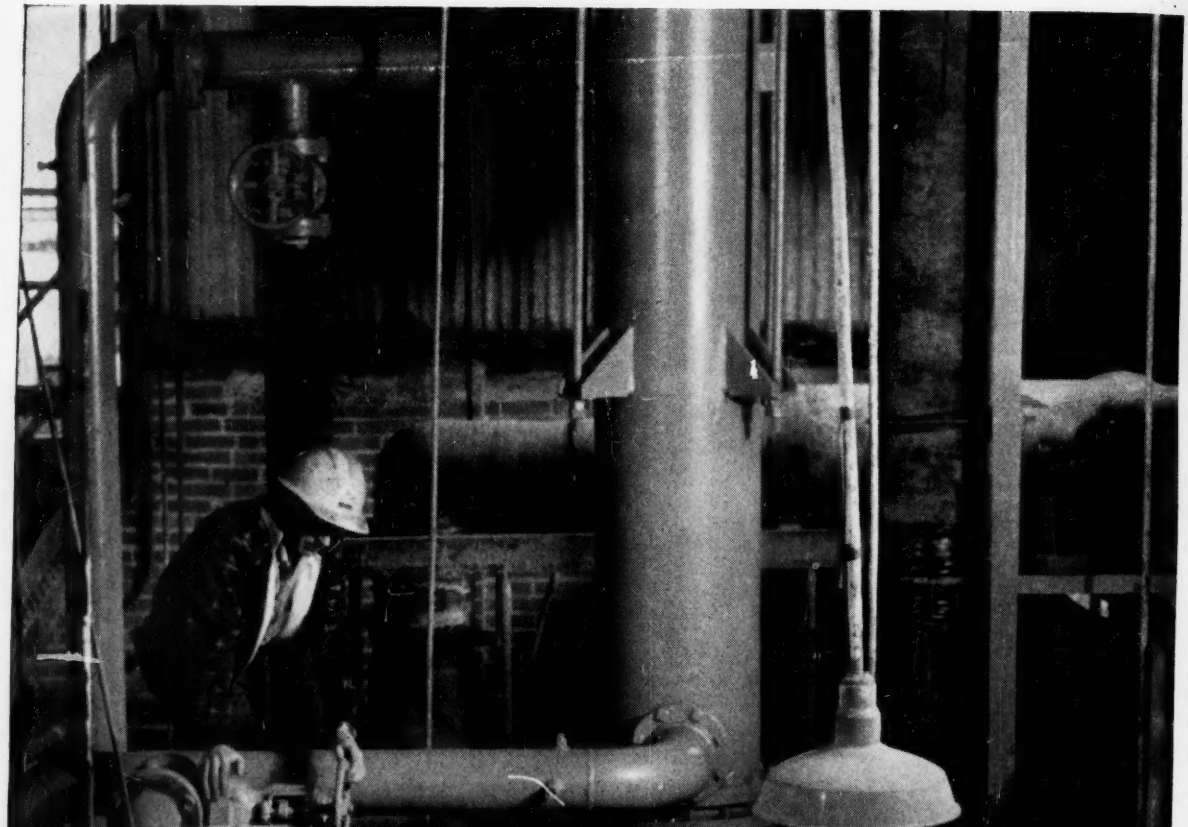
☐ a sample for conditioning..... (Name of your product)

Name.....Title.....

Company.....

City.....Zone.....State.....

FLUIDICS* AT WORK



TITANIUM CHLORINE COOLER REQUIRES NO MAINTENANCE

If you talked with the people at Stauffer Chemical Company, Niagara Falls, N. Y., you'd find they are not concerned that this chlorine gas cooler is located in a relatively inaccessible spot.

In fact, you'd learn that they placed it here deliberately in order to save production space within their plant.

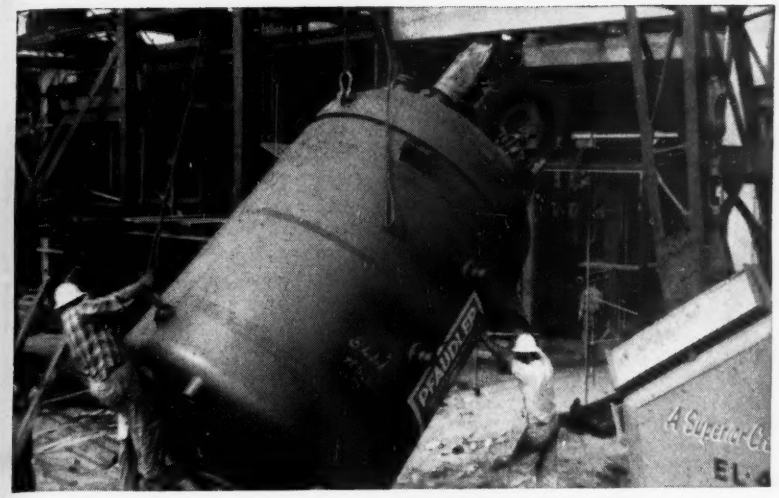
Why? It's made of titanium.

No down time. Installed in Cellhouse No. 1, where a heavy tonnage of chlorine is cooled daily, this 394 sq. ft. Pfaudler® heat exchanger cools chlorine gas from 75° to 40° C. Unlike the other coolers at Stauffer, this titanium unit has required *no* maintenance whatsoever since going into operation late in 1959.

Zero corrosion. This performance record is due to the fact that titanium is completely immune to corrosion by wet chlorine. Because of this, you can locate such coolers without regard to headroom. You don't have to worry about getting at them for inspection, cleaning, or other maintenance.

Sound investment. Moreover, the almost infinite service life of titanium in wet chlorine makes such a cooler an exceptionally sound investment. Compare titanium with other materials, taking into account length of service expected and maintenance required, and the economics of titanium will be apparent.

Availability. Along with titanium, Pfaudler also provides production-sized equipment made of tantalum and zirconium. For the full story, ask for Bulletin 978 —*Titanium, Tantalum and Zirconium Process Equipment by Pfaudler.* Address your inquiries to the address shown on the facing page.



On stream with Pfaudler

This could be your new plant. And one of the men at the site could be from our Field Service group.

His job? Supervising the installation of Pfaudler equipment. Giving expert attention to every detail during uncrating, rigging, erection and hook-up. Assuring operational efficiency.

Such responsibility is the task of our 15-man Field Service staff. The eldest in the group has been servicing Pfaudler equipment for 25 years. The rest? Varying amounts of time. All bring specialized knowledge and skills to the job; the kind that pay off handsomely for you.

These specialists now also offer complete *start-up service*. They check out the equipment, along with your piping —make sure you go on stream with complete confidence.

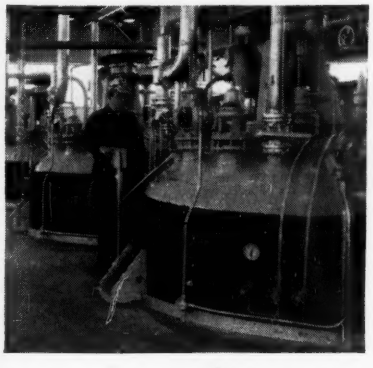
Emergency service is also part of our Field Servicemen's job. Like? When a fire damaged a customer's plant, a Pfaudler tank needed extensive repairs. Our men had the tank removed from the line, shipped it to our plant, and then reinstalled it—*all within a single week*.

These 15 men are strategically located throughout the country. Their services are literally as close to you as your phone.

For more details and cost information, call BEverly 5-1000 in Rochester, New York, and ask for CUSTOMER SERVICE. From then on, *your* problem is ours!

Glasteel helps set records with PVC

High yields, complete protection for product purity, and minimum down time is the story at Cumberland Chemical Corporation's plant (jointly owned by Air Reduction Company Inc. and The Ruberoid Company) at Calvert City, Kentucky.



Playing a major role in this record-setting performance are 14 Pfaudler Glasteel reactors. With good reason. Glasteel—glass inside, steel outside—is the ideal material for polymerization.

Its surface is corrosion resistant and exceptionally smooth, so PVC does not react with it or readily adhere. This keeps product losses down. It also means that complete cleaning is quick and sure. You can do it between batches with the Pfaudler glassed Spray Rinse valve.

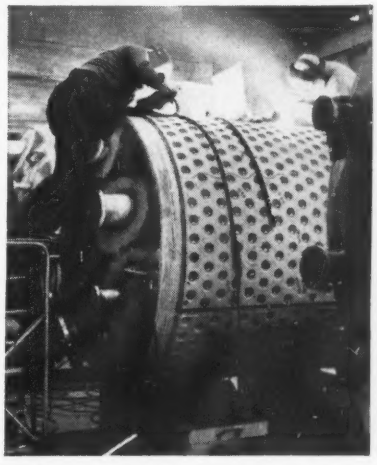
And, Glasteel will not contaminate or discolor any of the materials you use in making resins. Let us answer your questions in detail; ask for Bulletin 932.

Dimpled jacketed stainless reactors now rated at 180 psi

Dimpled jackets in themselves provide more effective heat transfer and higher pressures than heavier wall conventional jackets.

But, build them out of *Inconel* and you further extend design performance.

Now you can operate Pfaudler stainless steel reactors to 180 psi jacket pressure against full vacuum or a 75 psi internal. Inconel, as you would guess, is the jacket material.



Higher jacket pressure is one advantage, but an Inconel dimpled jacket offers these additional features:

1. Use any conventional jacket-heating medium including the chlorinated hydrocarbons and chloride brines.
2. Forget about surface corrosion on both inside and outside of the jacket.
3. Eliminate any concern you might have about stress-corrosion cracking.

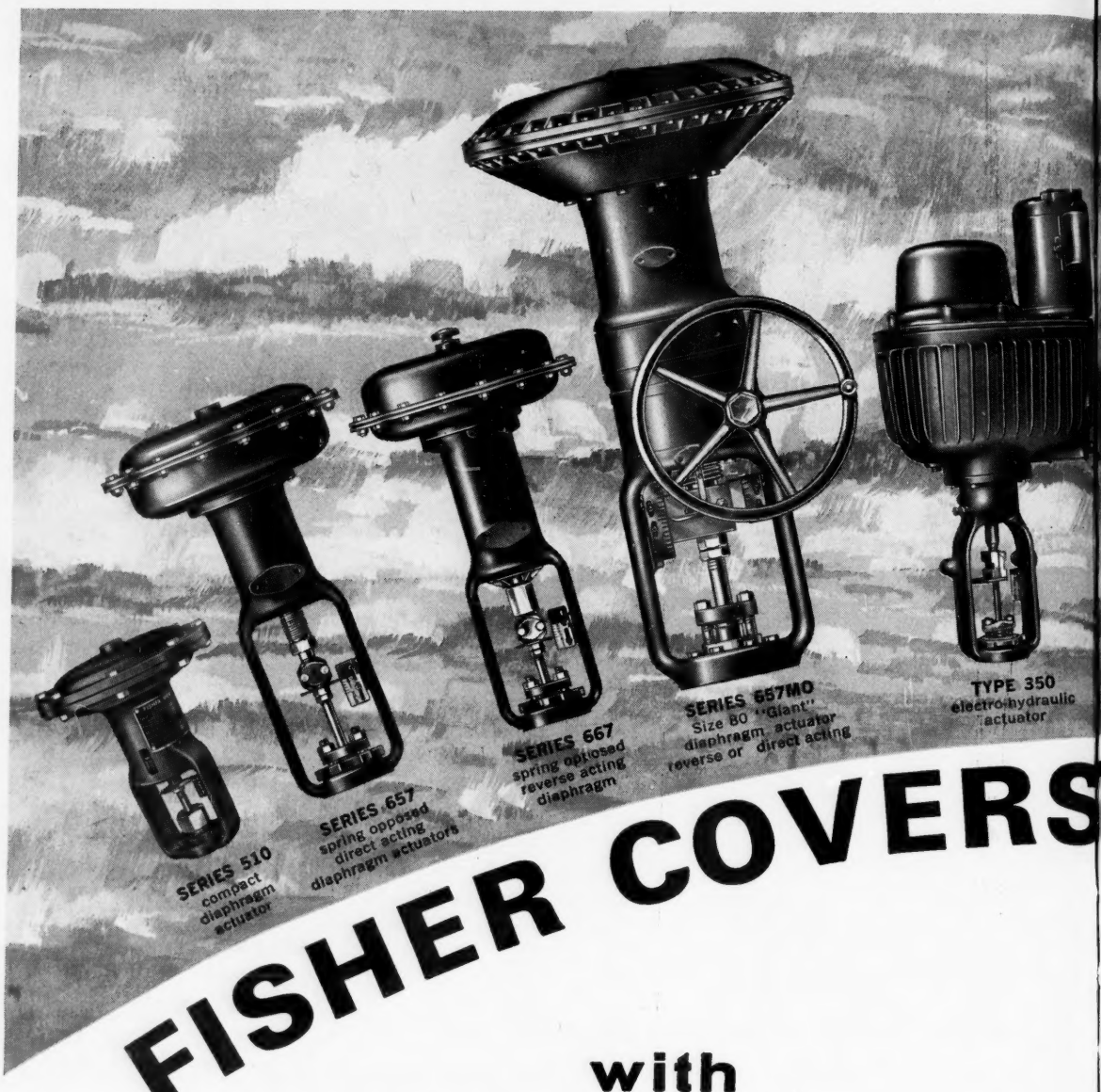
Inconel dimpled jackets are standard on all Pfaudler stainless steel reactors of from 750 to 4,000 gallons. Complete specifications are included in our *new* Bulletin 1005. For your copy, write to the address listed below.

Address all inquiries to: Pfaudler Division, Dept. CE-81, Rochester 3, New York.

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS . . . the science of fluid processes



FISHER COVERST

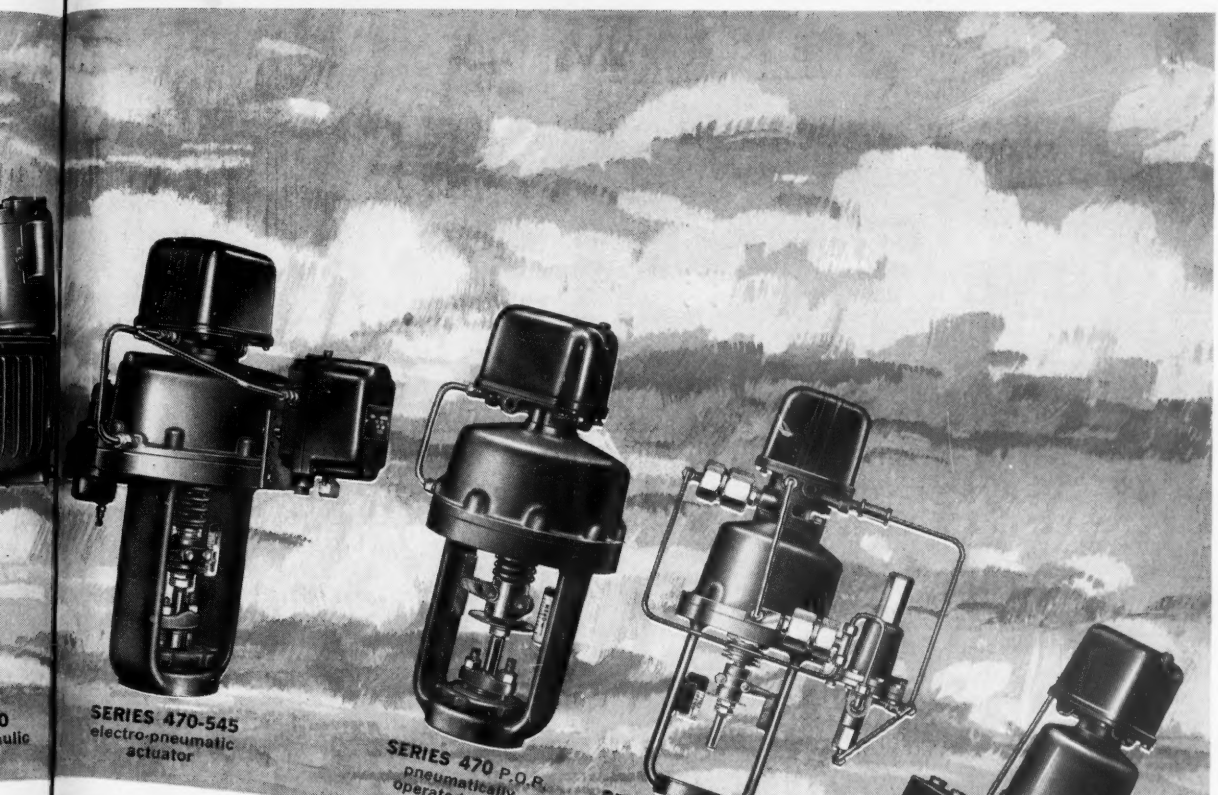
with INTERCHANGEABLE

For ALL Body styles

Just Off the Press!

A 64-page bulletin on Fisher Control valves is now available. Completely illustrated with diagrams, tables, performance charts, and other information of value to the instrument engineer. Write for your free copy of Bulletin E-600 today.

FISHER GOVERNOR COMPANY
MARSHALLTOWN, IOWA



THE HORIZON...

ACTUATORS

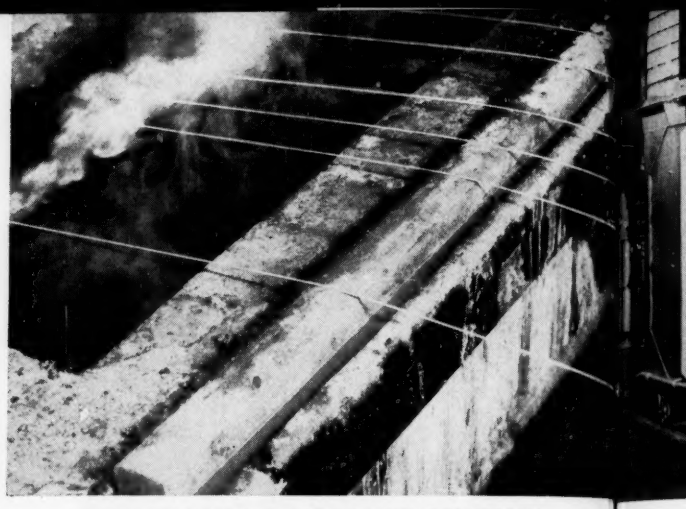
ALL Pressure, ALL Fluids

it flows through pipe anywhere in the world
...chances are it's controlled by.....

FISHER® Controls
SINCE 1880

Report from Carborundum:

6 ways to do jobs better with refractory materials



HANDLING MATERIALS IN ACID SOLUTIONS:
SILICON CARBIDE WEAR BLOCKS RESIST CORROSION AND ABRASION. Steel wire moving at 100 ft/min passes over CARBOFRAX® silicon carbide wear blocks to a pickling tank in the photo above. A 15% solution of sulfuric acid at 400 F is used. Sinker blocks are also of CARBOFRAX silicon carbide. Despite the action of the acid and the abrasion of the wire, the silicon carbide shows no wear after months of service. Similar applications involving Carborundum refractories are found in aluminizing and other wire coating baths.

DIRT-FI
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SKID RAILS IN REHEAT FURNACE:
SILICON CARBIDE RAILS LAST 30 TIMES AS LONG AS STEEL IN HIGH TEMPERATURE, ABRASIVE SERVICE. The 6¾" x 8" brass billets seen in the picture are pushed through a 38-foot long gas-fired extrusion mill furnace. Steel skid rails required replacement every five weeks. When CARBOFRAX silicon carbide rails were installed, 156 weeks of service were obtained. Reduction in downtime resulted in lower operating costs and higher production rates. Superior wear resistance and ability to withstand high temperatures make silicon carbide a profitable choice for applications like this.

LONGER LIFE FOR BURNER RINGS:
SILICON CARBIDE CONSTRUCTION WITHSTANDS FLAME EROSION AND HIGH TEMPERATURES. Refractory burner rings in pulverized coal-fired boiler frequently fail fast because of the abrasive action of the fuel particles and thermal shock due to intermittent operation. Many users have found an answer to the problem in CARBOFRAX silicon carbide rings. Silicon carbide is not only superhard, but also stays hard at high temperatures. High thermal conductivity and resistance to thermal shock minimizes cracking and spalling. Flame patterns are maintained.

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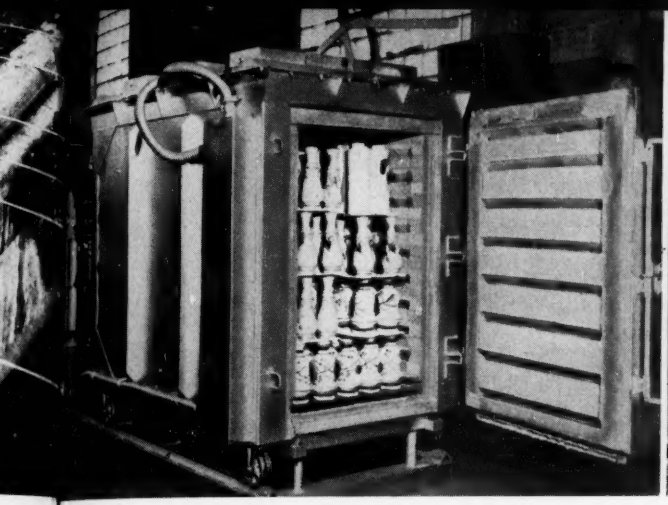
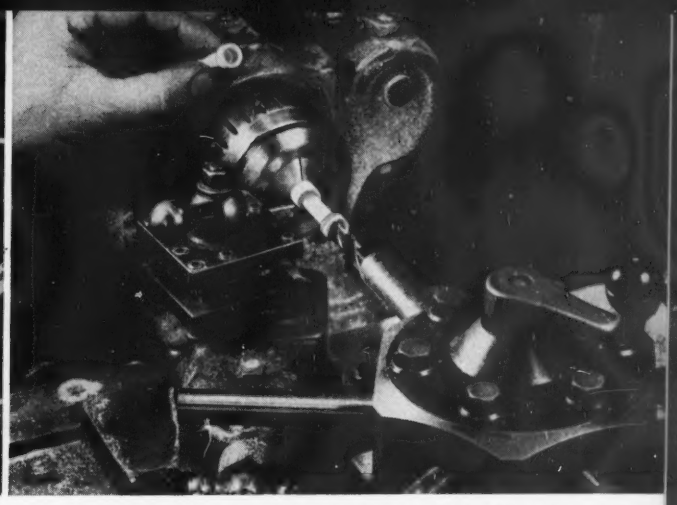
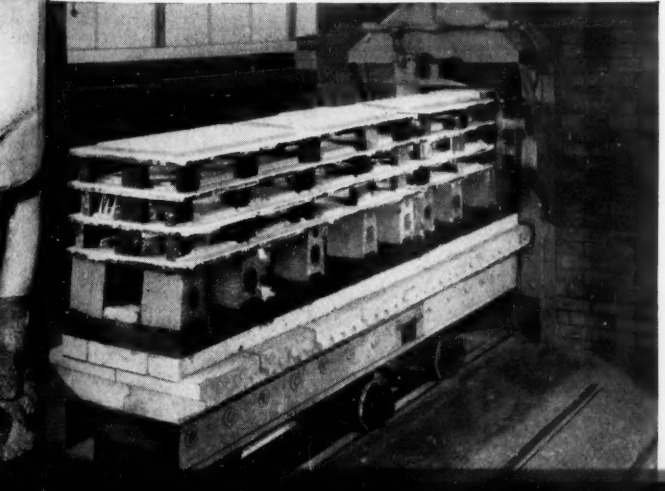


DIRT-FREE OPEN FIRING WITH MOVABLE KILN:
FIBERFRAX® CERAMIC FIBER LINING REPLACES BRICK: MAKES POSSIBLE TEMPERATURES UP TO 2200 F. The interesting movable kiln illustrated is made by Unique Kiln Co., Hillsdale, N. J. It moves on rails to enclose a stationary loading bed. Two beds can be serviced alternately. Door and hood linings of Carborundum's light-weight FIBERFRAX ceramic fiber, in block form, eliminate the problem of dislodged dirt and dust encountered with fireclay type refractories, which often damage ware being fired. High heat resistance and insulating properties of FIBERFRAX fiber make possible firing up to 2200 F.



SHAPES AND JIGS MACHINED FROM CERAMIC:
BORON NITRIDE IS EASILY MACHINED; RESISTS HIGH TEMPERATURES AND CORROSION. The photo shows the machining of a semi-conductor jig from Boron Nitride, a self-bonded material made by Carborundum. Close tolerances, high surface finish and intricate detail are possible. Boron Nitride offers advantages in semi-conductor production compared with graphite jigs, yields from which often drop 40% after only 50 cycles. The material also offers possibilities for insulating tubes and shapes; chemical equipment parts, crucibles, brazing fixtures, gaskets and seals. Shapes withstand furnace temperature of 3000 F; powder as high as 5400 F.

ELIMINATING CRACKING IN KILN CAR TOPS:
COMBINATION OF REFRACTORIES SOLVES PROBLEM IN CERAMIC INDUSTRY. Used in a gas-fired electrical porcelain kiln, the cars illustrated have been in service for more than two years at cycles of 14 to 15 hours, operating from cold to 2290 F to cold. Car top cracking due to heat shock has been eliminated by use of three different Carborundum refractories—a bottom layer of MULLFRAX® electric furnace mullite for high load carrying capacity, a middle course of ALFRAX® alumina "bubble" brick for insulation and an upper course of CARBOFRAX silicon carbide tile for resistance to thermal shock.



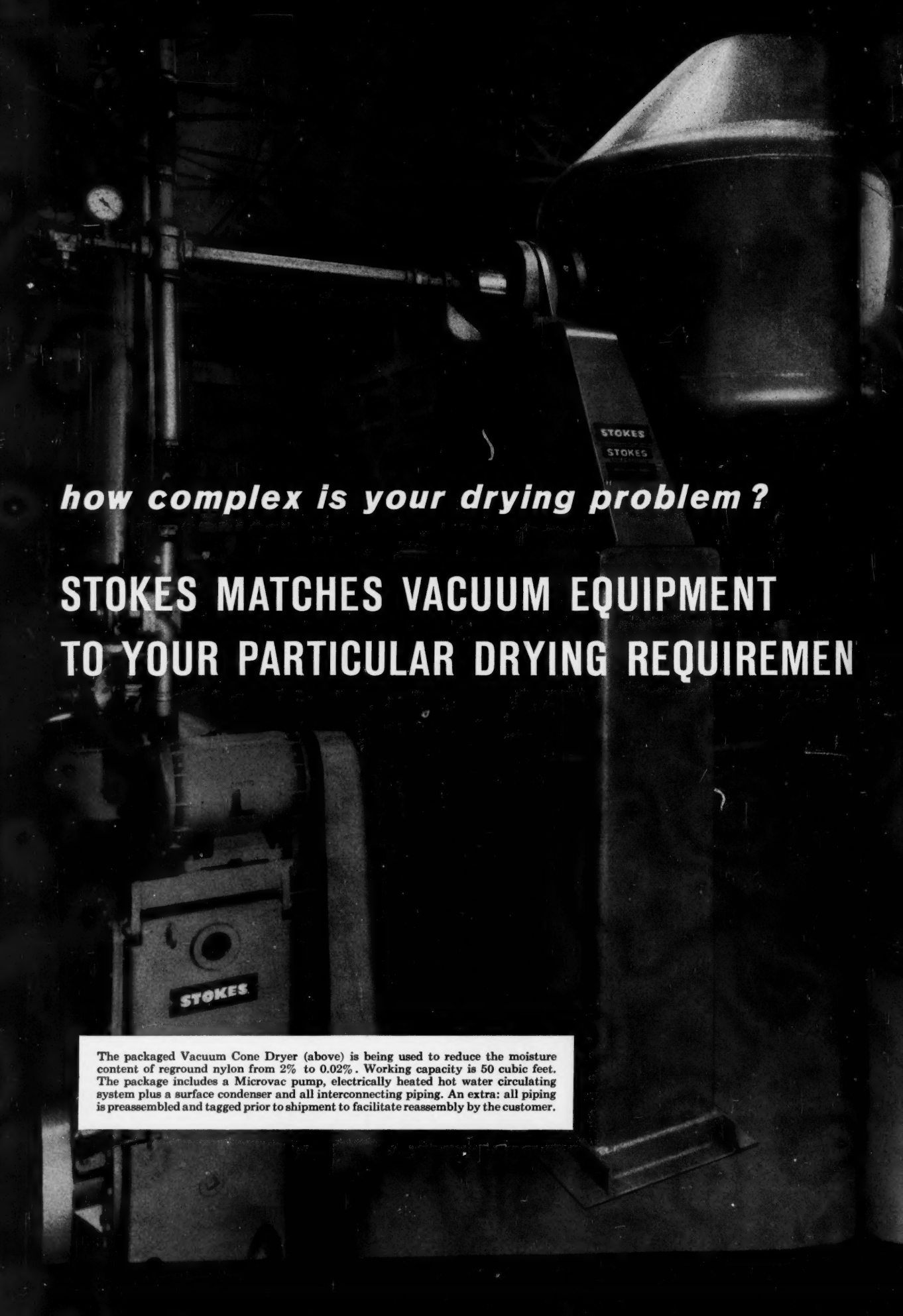
Want help on your problems?

Carborundum engineers will be glad to recommend refractories to answer your specific needs.

For information, contact Dept. H-81, Refractories Division, Carborundum Co., Perth Amboy, N. J. Descriptive brochures available on request. Please specify the area or areas of particular interest to you.

for engineered refractories...count on

CARBORUNDUM®

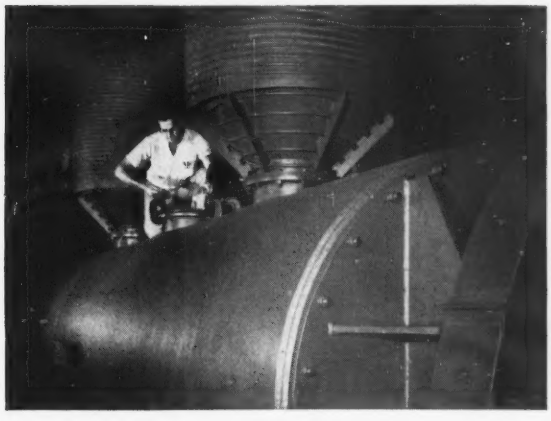


how complex is your drying problem?

STOKES MATCHES VACUUM EQUIPMENT TO YOUR PARTICULAR DRYING REQUIREMEN

The packaged Vacuum Cone Dryer (above) is being used to reduce the moisture content of reground nylon from 2% to 0.02%. Working capacity is 50 cubic feet. The package includes a Microvac pump, electrically heated hot water circulating system plus a surface condenser and all interconnecting piping. An extra: all piping is preassembled and tagged prior to shipment to facilitate reassembly by the customer.

The rotary vacuum dryer shown here is drying tonnage quantities of a chemical salt. This type of dryer is ideal for drying such critical materials as dyes, flocculants, fungicides, insecticides plus organic and inorganic salts. Stokes manufactures a complete line of vacuum drying equipment.



PROCESSING tonnage quantities of materials in an inadequate vacuum dryer can be time consuming and costly. That's why Stokes experienced vacuum engineers study each drying requirement individually . . . then design the drying system to meet your specific needs. Drying systems in capacities from a few pounds to several tons are available . . . along with application engineering, laboratory service and pilot plant operations. Stokes puts its 50 years of vacuum processing experience to work on every drying problem . . . bringing you both money-saving and quality results. What's more, Stokes manufactures all its own pumps and accessories to assure you one-manufacturer responsibility in addition to unparalleled vacuum know-how.

Stokes will thoroughly explore your production problems . . . make recommendations on the basis of a practical knowledge of process operations . . . and confirm the recommended equipment by actual pilot plant production in the Stokes laboratory, if necessary.

WRITE FOR HANDY GUIDE

New booklet gives important hints on vacuum dryer selection. It describes briefly shelf, cone and rotary dryers . . . their construction, their operation and different types of applications. Our representative in your area will be glad to discuss your drying problems with you and make detailed recommendations. Check CEC for his address and telephone number.

STOKES

Processing Equipment Division

F. J. STOKES CORPORATION

5500 Tabor Road, Philadelphia 20, Pa.

STOKES INTERNATIONAL: PHILADELPHIA • TORONTO • LONDON

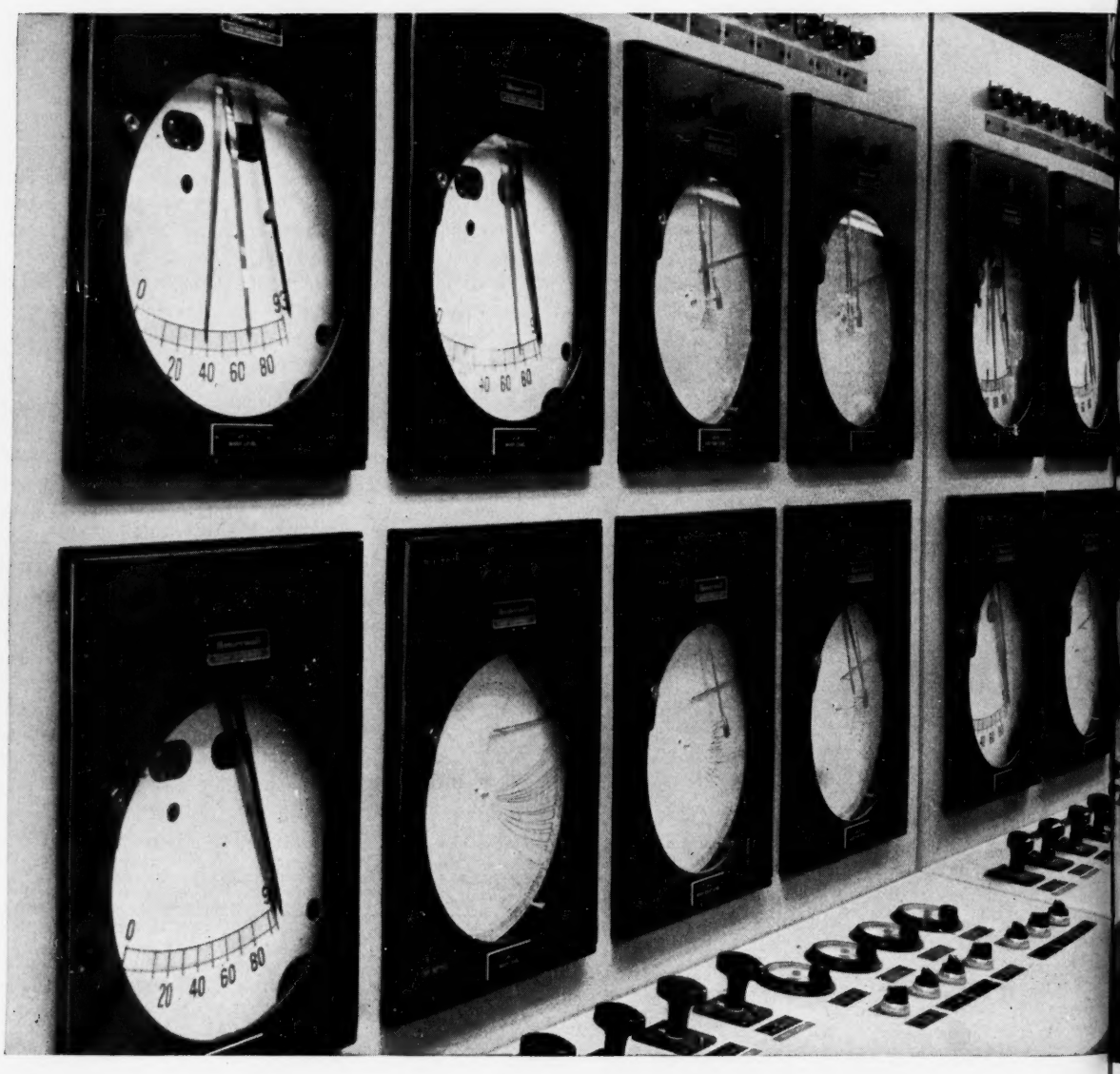
Stock proportioning goes automat

System improves product quality, cuts costs at Combined Locks Paper Co.

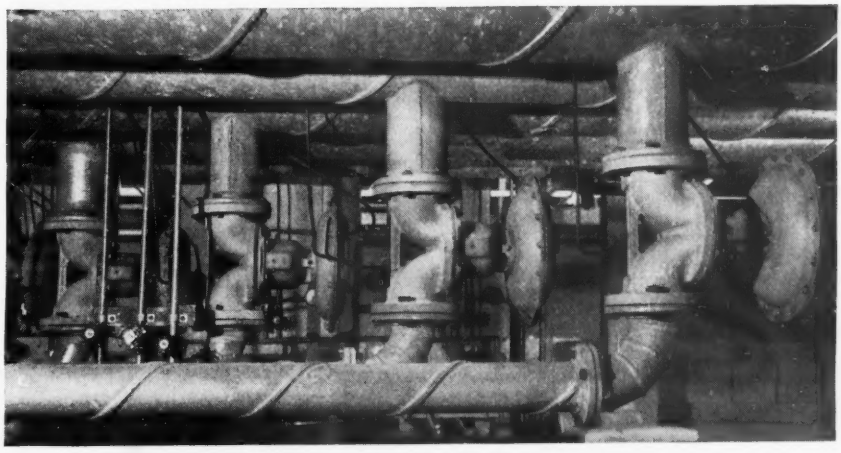
Automatic control has stabilized product quality and brightened the profit picture at Combined Locks Paper Company, Combined Locks, Wisconsin. The mill recently replaced manual controls for batch stock preparation with a system designed entirely by Honeywell, from level detector to valves. The system will pay for itself many times over in short order.

The Honeywell control system was designed to automate five existing mixing chests which were previously manually operated. Honeywell controls measure the level of stock in five mixers. Proportioning and sequencing for each blending system are completely automatic. The desired furnish can be reproduced identically from batch to batch by setting a repeat switch. Stock proportioning is varied simply by changing the control index of instruments on the panel. Because this automatic control is far more accurate than manual methods, product quality is uniformly high. Where operators previously had to stand by during the entire process, pushbutton simplicity now saves time, money, and tedious repetitive labor.

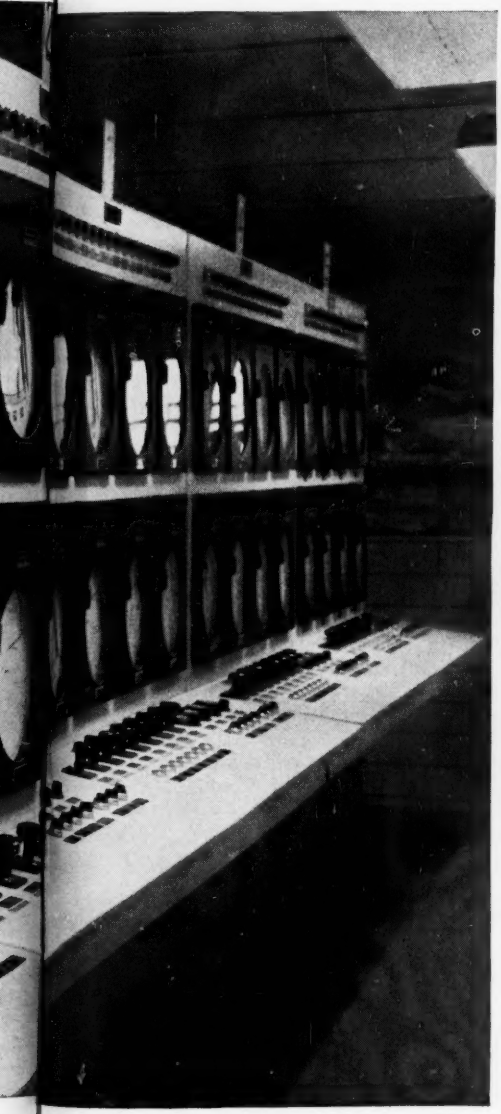
To automate a process in your mill, specify the results you want, and let Honeywell do the rest—everything from initial planning, through installation and startup, to maintenance. Call your nearby Honeywell field engineer—he's as near as your phone. MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.—In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

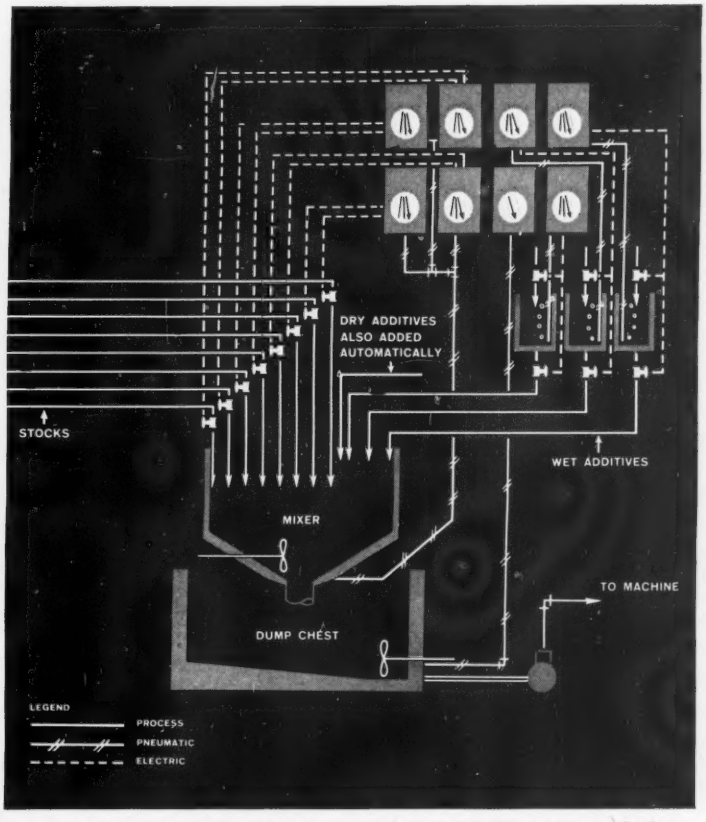


th Honeywell control system



Honeywell Saunders Control Valves regulate input stocks to five batch stock proportioning systems. (Use of repeat cycle provides continuous supply to machine.) The self-cleaning action of these valves makes them ideal for stock blending. Each of the five systems uses eight stock valves and six wet additive valves.





Honeywell instruments measure level of stock in five beaters and mixers. Sequence of stock additives can be changed from batch to batch or be reproduced exactly.

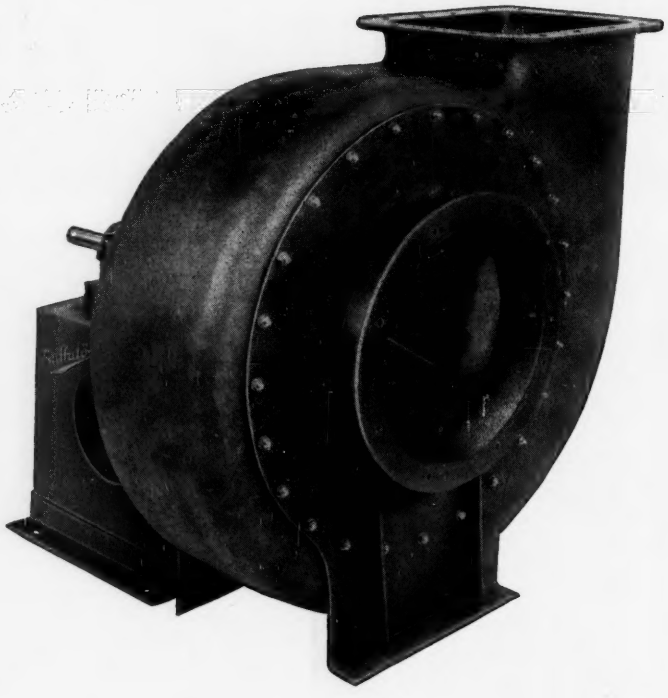
Honeywell

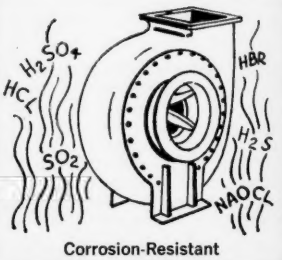
First in Control

SINCE 1885

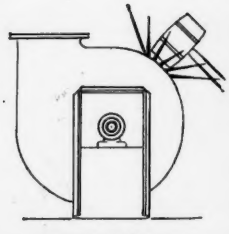
HONEYWELL INTERNATIONAL Sales and Service offices in all principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.

CORROSIVE FUMES MOVED with 'BUFFALO' Fiberglass Fans





Corrosion-Resistant


Impact-Resistant

Won't Support Combustion

Handle acids, salts, gases, organic materials and other corrosives in your venting systems without need for regular fan replacement. 'Buffalo' Type FG Fans in special resins withstand temperatures to 300° F. No metal parts exposed to corrosives. Flanged inlet and outlet for gas-tight connections. Capacities to 34,000 cfm, pressures to 10" static. Contact your resident 'Buffalo' Engineering Representative or write for Bulletin FI-511 which gives complete details including chemical resistance table.

"Buffalo"

AIR HANDLING DIVISION

BUFFALO FORGE COMPANY

Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

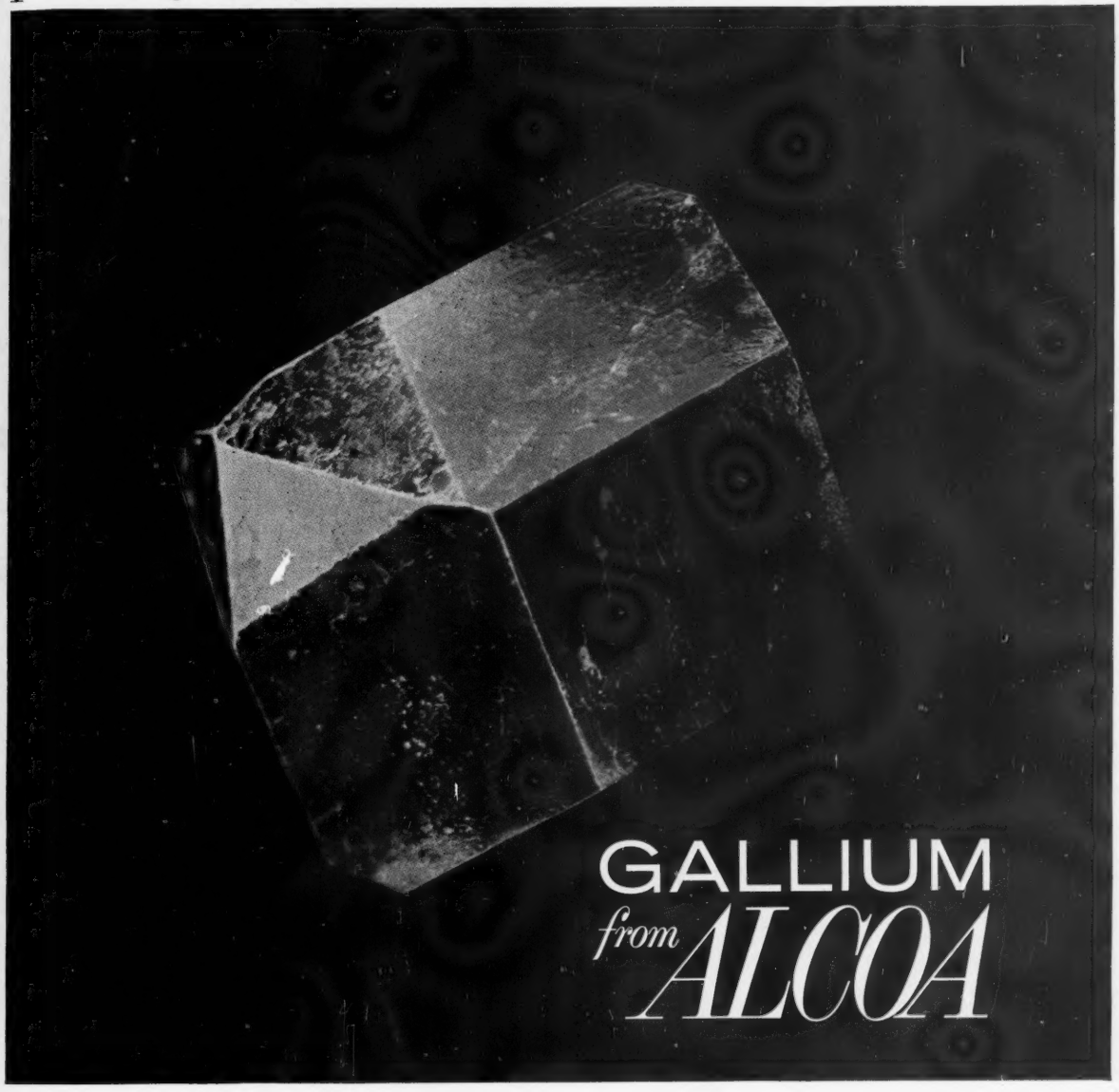
'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

probably the purest metal ever produced by man . . .



A curious metal is gallium. It melts in your hand, but doesn't boil until 1,983°C. Like water, but unlike most elements, it expands when solidified. Gallium exists in nature, particularly in aluminous ores of the bauxite type. But because of low concentration, it is not economical to process these ores for gallium content alone. Discovered in 1875, this rare metal only recently has shown commercial promise.

Gallium is extremely anisotropic. The variation in electrical resistivity is thought to be greater than for any other known metal. Gallium is widely used in semiconductor devices such as tunnel diodes, high-speed switches and microwave diodes. Gallium alloys readily with most metals, which leads to applications as cathodes in specialized vapor-arc lamps, in dental alloys, as low-resistance contact electrodes.

Gallium is used as a sealant for glass joints in laboratory equipment, particularly mass spectrometers and vacuum equipment. It shows promise as a heat transfer medium in nuclear reactors. It is added in small amounts to certain selenium rectifiers because it emits electrons at fairly low temperatures. It is being evaluated as thermionic valve cathodes for the same reason.

Today Alcoa produces three grades: 99.99 per cent pure, 99.999 per cent pure and 99.9999 per cent pure (Ga-4, Ga-5, Ga-6)—probably the purest metal ever produced by man. Alcoa's spectrographic and electronic techniques are the most rigorous and highly developed in the industry.

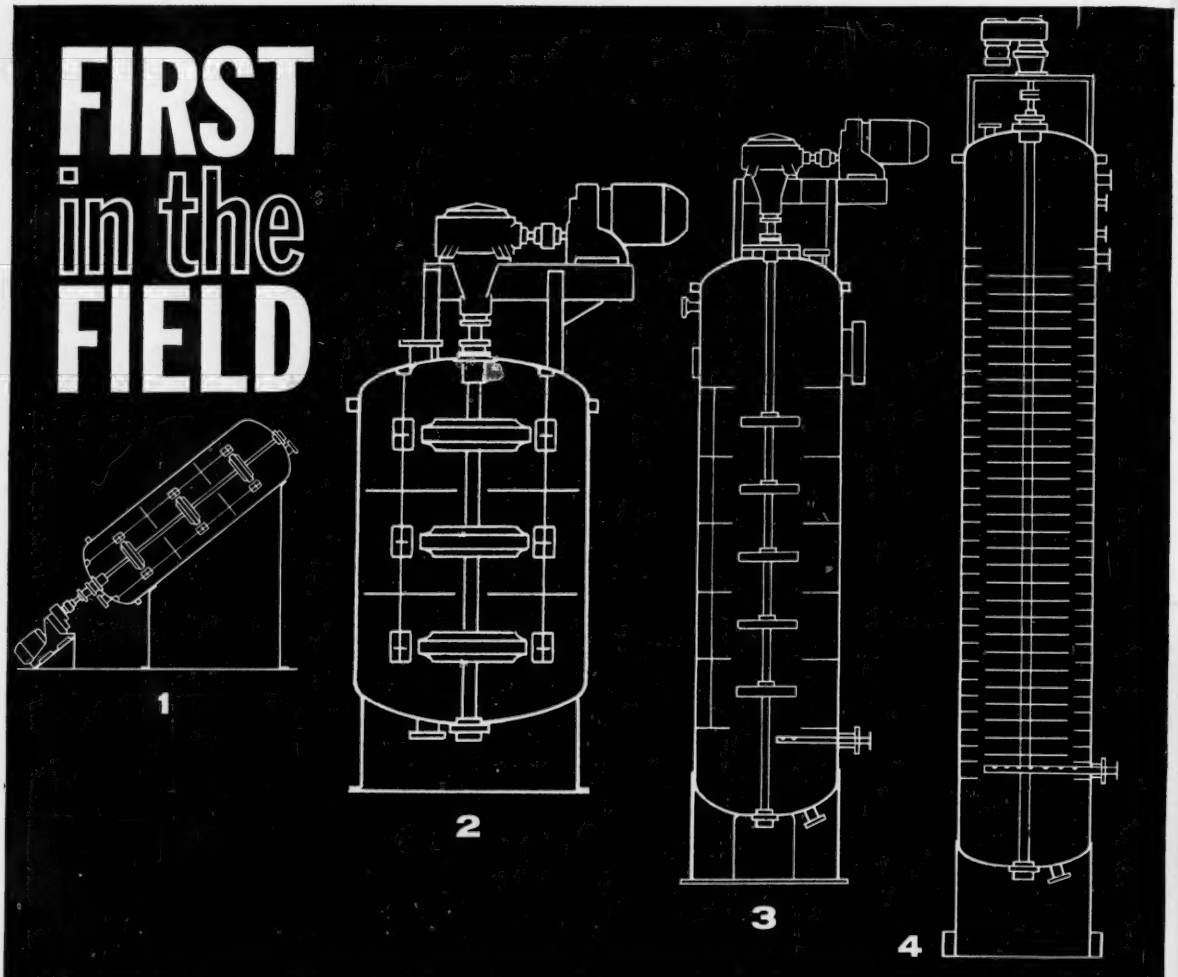
Are you interested in gallium applications—tried or untried? Our research and development people are available for discussion. Please write Aluminum Company of America, 705-H Alcoa Building, Pittsburgh 19, Pa.

For exciting drama watch "Alcoa Presents" every Tuesday evening—ABC-TV

ALCOA CHEMICALS

ALUMINUM COMPANY OF AMERICA

FIRST in the FIELD



1 First staged mixer (1933) supplied to industry. Designed and built by Turbo-Mixer.

2 Standard 4 stage concurrent mixer, supplied by Turbo-Mixer since 1935.

3 Concurrent or countercurrent Turbo-Mixer reactor built in any size or number of stages.

4 RDC* column built by Turbo-Mixer. Latest word for countercurrent extraction.

STILL 1st WITH THE BEST

Staged mixing equipment is an old and continued story with Turbo-Mixer. From the first staged mixer, patented in 1933, through constantly improved concurrent and countercurrent equipment to the Rotating Disc Contactor, the staged mixing and extraction equipment preferred in most industries, General American's Turbo-Mixer Division has led the way. You may be sure General American research and industrial knowhow will maintain this leadership.

Write for Bulletins #T-11 and #T-1159 for descriptive details!

Process Equipment Division—Turbo-Mixers

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South LaSalle Street
Chicago 3, Illinois

TURBO-MIXER GENERAL AMERICAN TRADE MARK

Offices in principal cities

*Patented

PLASTICS DIVISION CHEMICALS

PHENOL USP (SYNTHETIC)

Only Plastics Division can supply you with every grade of Phenol . . . both synthetic and natural. Our synthetic Phenol . . . made to very exacting specifications . . . is right for all applications. In fact, it is one of the few Phenols pure enough for use in the production of Nylon 6! And when you order Plastics Division Phenol, you get more than a top-quality product. You get the absolute assurance of a regular supply . . . one that will satisfy your requirements throughout the years. Next day delivery in the East and Midwest can be depended on, too, for we now have storage facilities in Toledo, Ohio, as well as at our Philadelphia plant. Look to the natural Phenols to save you money—particularly in resins, lube oil extraction, and alkyd phenols. A highly versatile chemical, Phenol, is valuable in the manufacture of nylon and epoxy resins, medicinals, dyes, photographic developers, plasticizers, wood preservatives, weed killers, insecticides, and anti-oxidants.

TAR ACIDS

Our standardization methods insure regular shipments of the highest quality tar acids. We not only can give you the blend you need, but will be happy to help you solve any tar acid problems.

Phenols Synthetic & Natural

Technical Phenol (all grades)
Phenol-Cresol Mixes
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Cresols

Cresol, USP
Ortho Cresol (from 50% to 98+% purity)
Meta/Para Cresol
Resins Cresols
Special Cresol Fractions blended to order

Cresylic Acids

Specially blended mixtures of close-cut fractions
Special Engine Cleaning Grades

Xylenols

Metaxylenol—45°C., 56°C., and 61.2°C. Min. M.P.
Crude and Refined Grades
Special Fractions

A-C® POLYETHYLENE

Combine these unusual characteristics—high melting point, low melt viscosity, resistance to water and to most chemicals (at room temperature), compatibility with waxes and wax-like materials—and you get A-C Polyethylene, the coating that is exactly right for so many varied applications. **For paperboard coatings:** improves gloss and gloss retention, adds resistance to blocking and abrasion and to chemicals, increases tensile strength, frequently cuts down on wax consumption, can be run on conventional equipment. **For fabrics:** treatment with an A-C Polyethylene emulsion improves tear strength, abrasion resistance, crease recovery and resistance to needle cutting. **For blending:** can be used in polishes, candles, electrical insulations, rubber, and in many different operations. And new uses continue to be discovered every day. Looking for a chemically inert coating? One that is both tasteless and stable in the presence of organic liquids? A-C Polyethylene may solve your problems. Call us at any time for technical assistance.

ELASTEX® PLASTICIZERS

Each of Allied Chemical's plasticizers has special properties that can improve a variety of products. "Elastex" 90-P Plasticizer is a good example. It offers electrical insulation performance substantially equivalent to that of high quality DOP, plus superior retention of elongation after severe heat-aging. It is recommended for use in vinyl compounds for high temperature wire insulation. Why not look into the whole family of Elastex Plasticizers? Most likely one or another of them can improve the product you manufacture.

Dibutyl Phthalate*
Dimethyl Phthalate*
DCHP Plasticizer — Dicyclohexyl Phthalate
10-P Plasticizer*— (Diisooctyl Phthalate) (DIOP)
28-P Plasticizer*— Di-2-Ethylhexyl Phthalate (DOP)
18-P Plasticizer*— Isooctyl Isodecyl Phthalate
20-A Plasticizer*— Diisodecyl Adipate
40-P Plasticizer*— Butyl Isodecyl Phthalate
48-P Plasticizer*— Butyl Octyl Phthalate
50-B Plasticizer*— Butyl Cyclohexyl Phthalate
60-A Plasticizer*— Di2-Ethylhexyl Adipate
82-A Plasticizer — Normal Octyl—Normal Decyl Adipate
82-P Plasticizer*— Normal Octyl—Normal Decyl Phthalate
90-P Plasticizer*— Diisodecyl Phthalate
36-R Plasticizer — Medium molecular weight polymeric plasticizer
Plasticizer 136* — An aryl Alkyl hydrocarbon

*Available in Tank Cars or Trucks

ACETONE

When used in cellulose acetate and epoxy resins, acetone must be especially free from contaminants. That's why Plastics Division's super-pure acetone is preferred for these applications—and for use as a solvent, in many chemical extractions and syntheses, and as an intermediate in chemical and drug manufacture. Fast delivery by tank car from Philadelphia, or by tank truck from our supply depots in Boston, Buffalo, Chicago, Cleveland, Detroit, Indianapolis, Los Angeles, New York, Philadelphia, and St. Louis. Drum stocks at all of these points and at Charlotte, N. C.

INDUSTRIAL AROMATIC SOLVENTS

You can count on a stable supply of aromatic solvents from Allied Chemical— and they'll be of the highest reliability, too. For Allied played a pioneering role in standardizing testing methods and specifications for light oil distillates. If your plant is within 100 miles of one of our ten nation-wide tank wagon stations, you get prompt delivery by our own tank trucks. And from most of our stations, you can order acetones, glycols, and phthalate plasticizers for combination delivery with our aromatic solvents.

Benzol, Nitration
Benzol, Industrial Pure
Benzol, Industrial 90%
Benzene, Thiophene-free
Toluol, Nitration
Toluol, Industrial Pure
Xylol, Nitration
Xylol, Ten Degree
Xylol, Industrial
Hi-Flash Solvent
1320 Oil
Wire Enamel Solvent

Also available in Tank Cars

PHTHALIC ANHYDRIDE Low cost, ease of handling, versatility... these, along with the outstanding chemical and physical properties it imparts, are reasons behind the growing demand for phthalic anhydride. Now the laboratories of Allied Chemical add another: exceptional purity. The result? Significant improvement in quality for alkyd and polyester resins, plasticizers, fine chemical syntheses and dyes, pharmaceuticals, and many other products. Our conveniently located plants and warehouses assure fast, dependable delivery of phthalic anhydride in liquid and flake form. Technical assistance upon request.

NIACIN In pharmaceuticals, in animal and poultry feeds, in the enrichment of flour, Niacin plays an important role. Naturally these applications demand the highest purity—and Plastics Division Niacin satisfies that demand. It meets the highest USP standards of purity and is recommended for use in the blending of vitamin premixes. All grades, including feed grain Niacin of 50% to 80% purity, are available from our manufacturing plant in Philadelphia and our warehouses in Los Angeles and Chicago.

TAR BASES Possibilities for these versatile chemicals seem almost limitless. Already tar bases have found important application in such diverse fields as water repellents, antihistamines, and stabilizers for chlorinated solvents. So that you can explore their use in your industry, Plastics Division will be glad to send you samples and technical data.

OTHER CHEMICALS AND PRODUCTS

ACETOPHENONE
ADIPID ACID
CUMENE
CUMYLPHENOL
CYCLOHEXANOL
CYCLOHEXANONE
DIETHYLENE GLYCOL
ETHYLBENZENE
ETHYL GLYCOL
FLOTATION AGENTS
FUMARIC ACID
MALEIC ANHYDRIDE

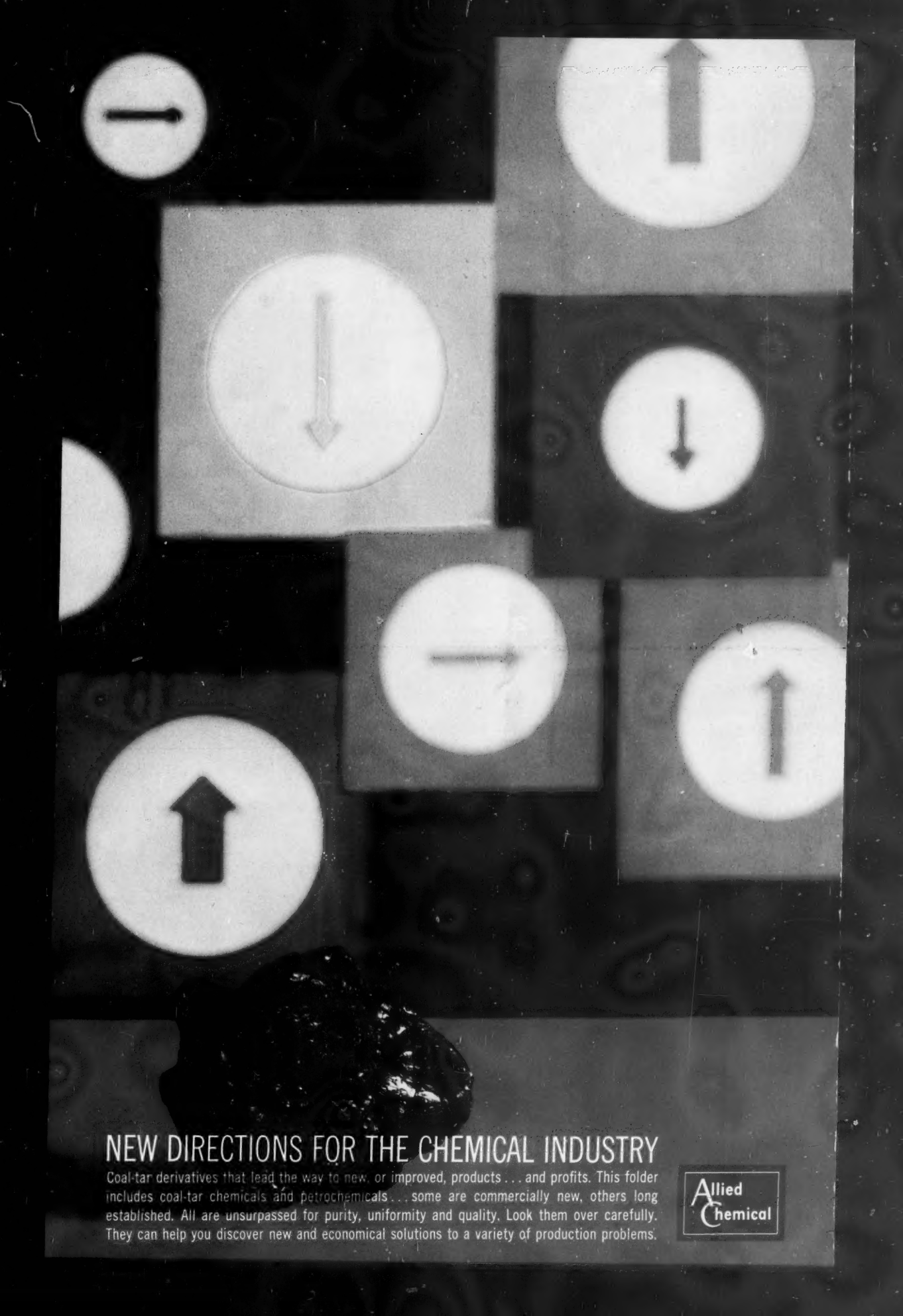
(continued below)

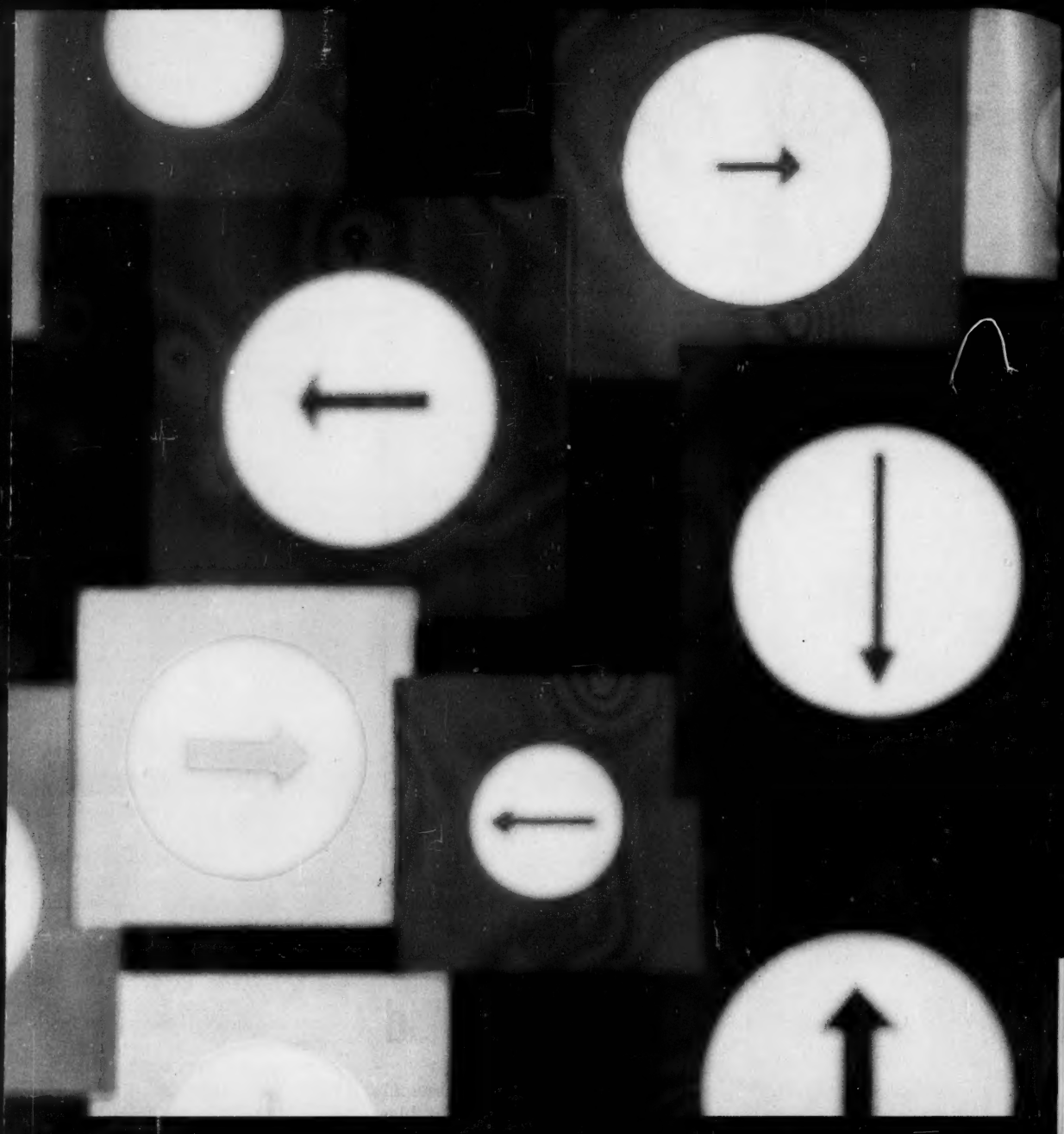
ALPHA-METHYLSTYRENE A low cost unsaturated aromatic monomer, our alpha-methylstyrene is produced by a cumene-phenol operation and is highly pure (99.5+%). It is used in styrenated alkyd resins... high-heat distortion polystyrene ...polyesters... the manufacture of cumylphenol... ion exchange resins... and polymeric plasticizers. Alpha-methylstyrene also co-polymerizes with a wide variety of unsaturated compounds, including butadiene, terpenes, acrylates, methacrylates and most vinyl monomers.

ANTHRACENE Recent studies have revealed new and important information about anthracene reactions. Did you know that Diels-Alder adducts are potentially useful as intermediates for plasticizers, adhesives, tanning agents, synthetic dyestuffs, and synthetic beater sizes for paper? Or that Friedel-Crafts reactions with olefins provide resins and pour-point depressors for lubricating oils? Well, these are just a few of the many anthracene reactions that lead to commercially valuable products. Also, anthracene is photoconductive and reacts photochemically. (And our anthracene is 90-95% pure.)

CUMAR® RESIN Because "Cumar" Resin ranks first in its field for purity and quality, it is well worth the little extra it costs. A versatile thermoplastic resin, it is available in nine separate grades. Most frequent applications: floor tile, aluminum paint, rubber products (both natural and synthetic), waterproofing materials and adhesives.

METHANOL
PICKLING INHIBITORS
RESIN **S** (A natural synthetic resin of high styrene content)
RUBBER COMPOUNDING MATERIALS
TAR ACID-OILS
TAR DISTILLATES


NEW DIRECTIONS FOR THE CHEMICAL INDUSTRY
Coal-tar derivatives that lead the way to new, or improved, products . . . and profits. This folder includes coal-tar chemicals and petrochemicals . . . some are commercially new, others long established. All are unsurpassed for purity, uniformity and quality. Look them over carefully. They can help you discover new and economical solutions to a variety of production problems.
Allied Chemical



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Efficient handling and shipping in modern stainless-steel tank trucks assure prompt delivery of all the pure, uncontaminated Plasticizers you need. For express tank truck deliveries, call the Plastics Division office nearest your plant:

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Buffalo	TR 3-3600	Los Angeles	NEvada 6-2306
Chicago	MIchigan 2-1800	New York	HAnover 2-7300
Cleveland	HEnderson 2-2020	Newark	MItchell 2-0960
Detroit	VInewood 2-2500	Philadelphia	JEfferson 3-3000
Houston	WAlnut 3-2871	St. Louis	PLainview 6-3404

FOR THE LATEST INFORMATION ON COAL-TAR CHEMICALS . . . WRITE US, AND WE WILL SEND YOU HELPFUL PRODUCT DATA ESPECIALLY COMPILED FOR YOUR INDUSTRY. IF YOU WOULD LIKE EXTRA COPIES OF THIS FOLDER, ASK FOR FORM P.D. 350.

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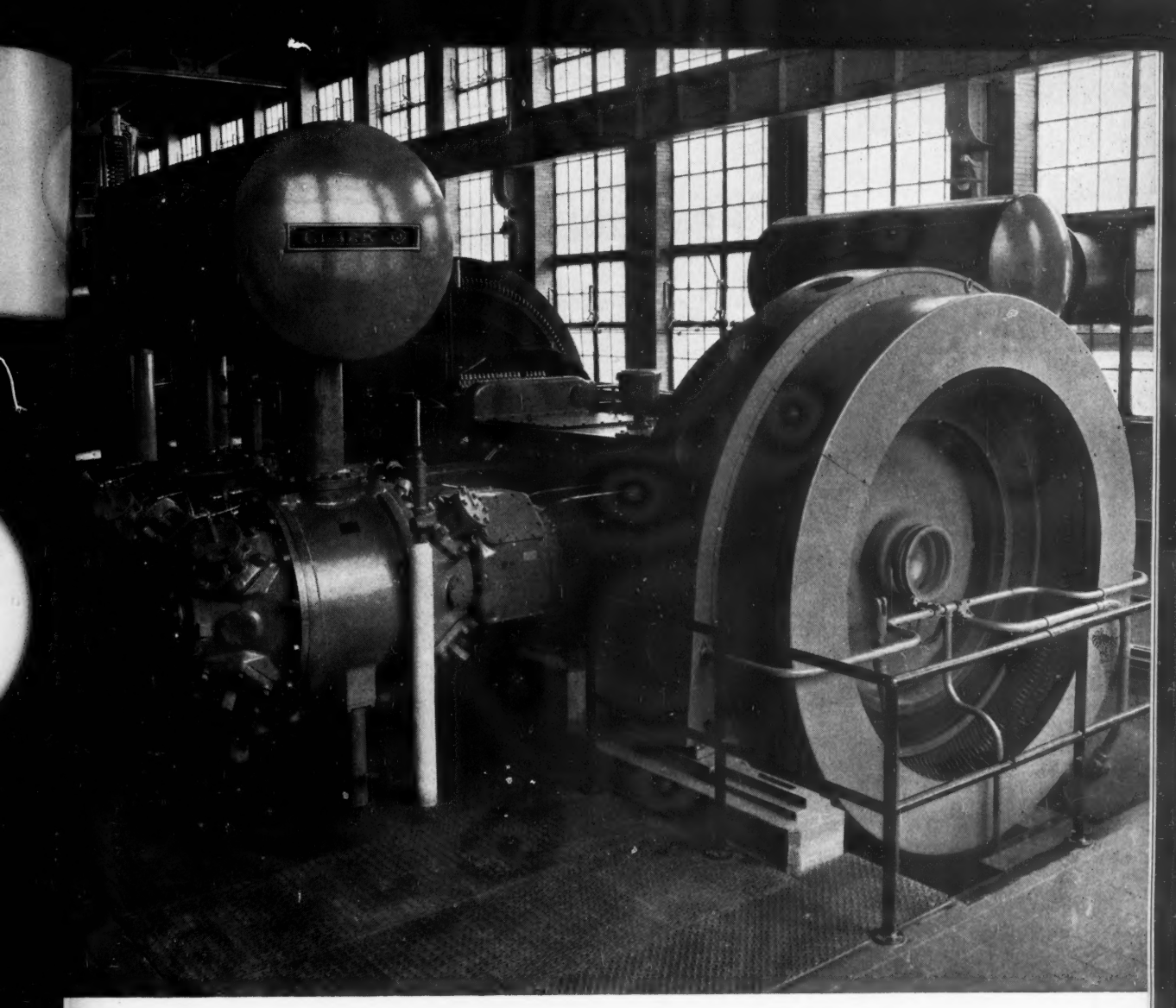
PLASTICS DIVISION

40 RECTOR STREET, NEW YORK 6, N. Y. • IN CANADA: ALLIED CHEMICAL CANADA, LTD., 1450 CITY COUNCILLORS ST., MONTREAL



Clark Air Compressor Keeps Lid On Maintenance!

Just Plain Dependable—That's the only way to describe this 2000 bhp Clark CBA-4 Balanced/Opposed Compressor. Ten years ago it was installed in the assembly plant of a major Detroit automotive manufacturer. To date, there has been no forced downtime other than scheduled maintenance overhauls.

On Duty 16 Hours a Day, five days a week, the compressor operates as a base load machine supplying 10,000 cfm of air at 105 psi. This is rated at 8% of total plant air utilized to operate the assembly line, paint shops, glass plant, blast furnaces and other functions.

Under a Preventive Maintenance Program, the compressor is overhauled once every two years. After 10 years of service, the valves are still original equipment. Bearings are also original equipment and have required no maintenance since startup.

Besides this Trouble-Free Performance, the user is on the "plus" side in many other respects. Among them: Smooth operation achieved by Clark Balanced/Opposed design; compactness that saves floorspace; simplified, reduced foundation requirements; inherent accessibility; marked simplicity of design.

Covering a Range of 75-8000 BHP, the Clark Balanced/Opposed, Motor-Driven line is increasingly becoming industry's preference for plant air requirements. Complete details are obtainable in Bulletin 185. Write now for your copy or get the facts first hand from your nearest Clark representative.

ROOTS CONNERSVILLE® Blowers, Compressors, Gas Pumps, Rootsmeters, Vacuum Blowers

Working together in allied industries . . .

PODBIELNIAK Centrifugal Contactors, Distillation Apparatus,

CLARK

ONE OF THE DRESSER INDUSTRIES®

DRESSER INDUSTRIES INC.

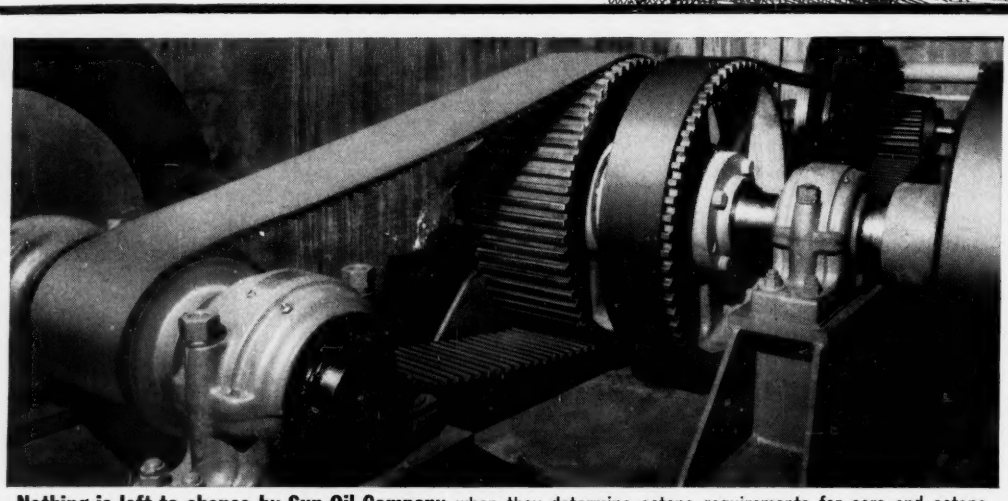
OIL • GAS • CHEMICAL
ELECTRONIC • INDUSTRIAL

CLARK BROS. CO.

OLEAN, N. Y.

Engines • Compressors

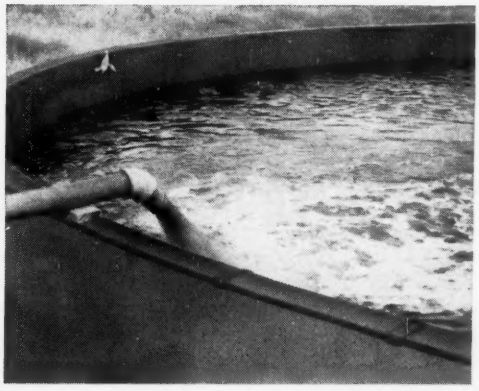
AT THE HEART OF INDUSTRY...



Nothing is left to chance by Sun Oil Company when they determine octane requirements for cars and octane ratings of fuels. Highly precise scientific equipment is used. This equipment is driven by a U. S. PowerGrip "Timing" Belt. This belt was a must because it gives foolproof, positive drive transmission, does not require lubrication, maintenance, or attention.

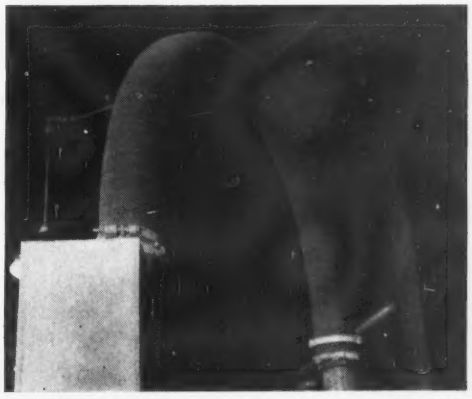
TB 107

Wherever the chemical industry and its related affiliates operate, you'll find U.S. Rubber Industrial Rubber Products helping them to function more efficiently...more profitably, helping to shorten the path to even more outstanding developments and products.



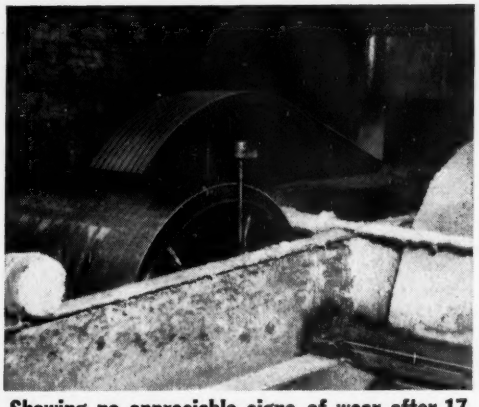
"Permobond lining should last 7 times longer on our 100,000-gallon hydrofluorosilicic acid storage tanks," says the superintendent at Kaiser Aluminum's Mulberry, Fla., plant. U.S. Permobond® linings are expected to last 15 to 20 years, are especially suited for highly corrosive "problem" chemicals, can be applied to both existing and new equipment.

TL 101



Carrying 200 gallons of ferro silicon per minute is all in a day's work for limber, abrasion-resistant U.S. Pilot® Pipe in a large iron ore producer's heavy media department. Company records show U.S. Pilot Pipe lasts about 12 times longer than metal pipe, requires no maintenance, saves room by eliminating the need for elbows.

H 113



Showing no appreciable signs of wear after 17 years of hard usage carrying power to the John A. Manning Paper Company's beater drive, this set of U.S. Royal V-Belts looks good for many more years of service. Known for maximum reliability and safety, U.S. Royal V-Belts provide top efficiency, exceptional length stability, and long service life for all types of drives.

VB 111

For every industrial rubber product need, turn to US. For Conveyor Belts, V-Belts, the original PowerGrip "Timing"® Belt, Flexible Couplings, Mountings, Fenders, Hose and Packings... custom-designed rubber products of every description. Discover why U.S. Rubber has become the largest developer and producer of industrial rubber products in the world. See your U.S. Rubber Distributor or contact US directly at Rockefeller Center, New York 20, N. Y.

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

United States Rubber

MECHANICAL GOODS DIVISION

PEERLESS PUMPS
INTEGRATED DESIGN
SUPERIOR DESIGN + TOP QUALITY CONSTRUCTION
+ MAXIMUM INTERCHANGEABILITY
+ OPTIMUM MATERIAL GROUPS AVAILABLE
= BROADEST HYDRAULIC COVERAGE
WITH MINIMUM CUSTOMER INVENTORY
OF PUMPS AND COMPONENTS
PEERLESS PUMPS

MEANS YOU CAN QUICKLY MODIFY THE SAME PUMP FOR DIFFERENT CAPACITIES

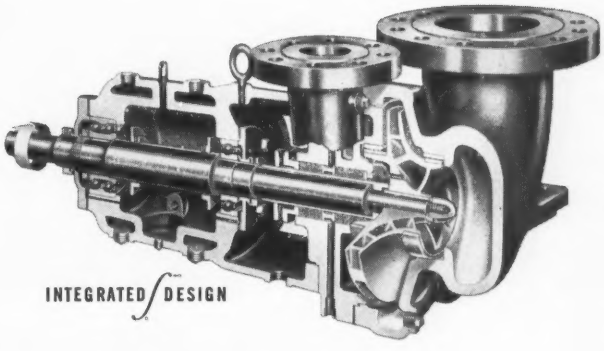
Component interchangeability permits desired pump to be assembled from standard components in a minimum of time.

Recently a large process plant in the gulf coast decided to increase its output. In the process of redesign it became necessary for a particular group of pumps to handle double their capacity. Because these pumps were integrated Peerless Type PR units, the solution was simple. By merely changing the impeller and volute, these pumps were ready to handle the higher pumping capacities required.

Unusual example? Not at all. Rather it is typical of the versatility designed and built into this line of high pressure, high temperature Peerless process pumps. Peerless PR and PRS pumps offer many other advantages. Virtually all liquids in refining processes can be pumped by these units. Widest capacity and head conditions are easily met. And the maximum interchangeability factor materially reduces inventory costs. Get the best for process pump needs, specify and buy Peerless. Send for informative Bulletin No. B-1605 now.

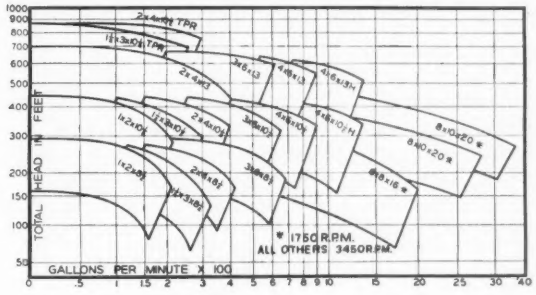
INTEGRATED DESIGN FOR GREATER EFFICIENCY AND ECONOMY

PEERLESS PUMP



PEERLESS PR AND PRS PUMPS ARE AVAILABLE IN 1″ TO 8″ SIZES INCLUSIVE

Designed to handle hot oil, hot water, hydrocarbons and many chemicals used in the process industries. Capacities to 3000 gpm. Heads to 700 feet. Type PR (packing gland construction) handles temperatures to 850° F. Type PRS (mechanical seal) handles temperatures to 250° F. Liquid ends available in any machineable metal. Electric drive is standard: other drives as required.



Putting Ideas to Work

fmc CORPORATION

Peerless Pump HYDRODYNAMICS DIVISION

Offices:
New York; Detroit; Cleveland; Chicago; Indianapolis; St. Louis; San Francisco; Atlanta; Plainview; Lubbock; Phoenix; Albuquerque; Los Angeles; Fresno.

Distributors in principal cities. Consult your telephone directory.

Peerless Pump, Hydrodynamics Division, Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, California

Please send me Bulletin B-1605 ☐ Have field engineer contact me ☐

Name_____

Address_____

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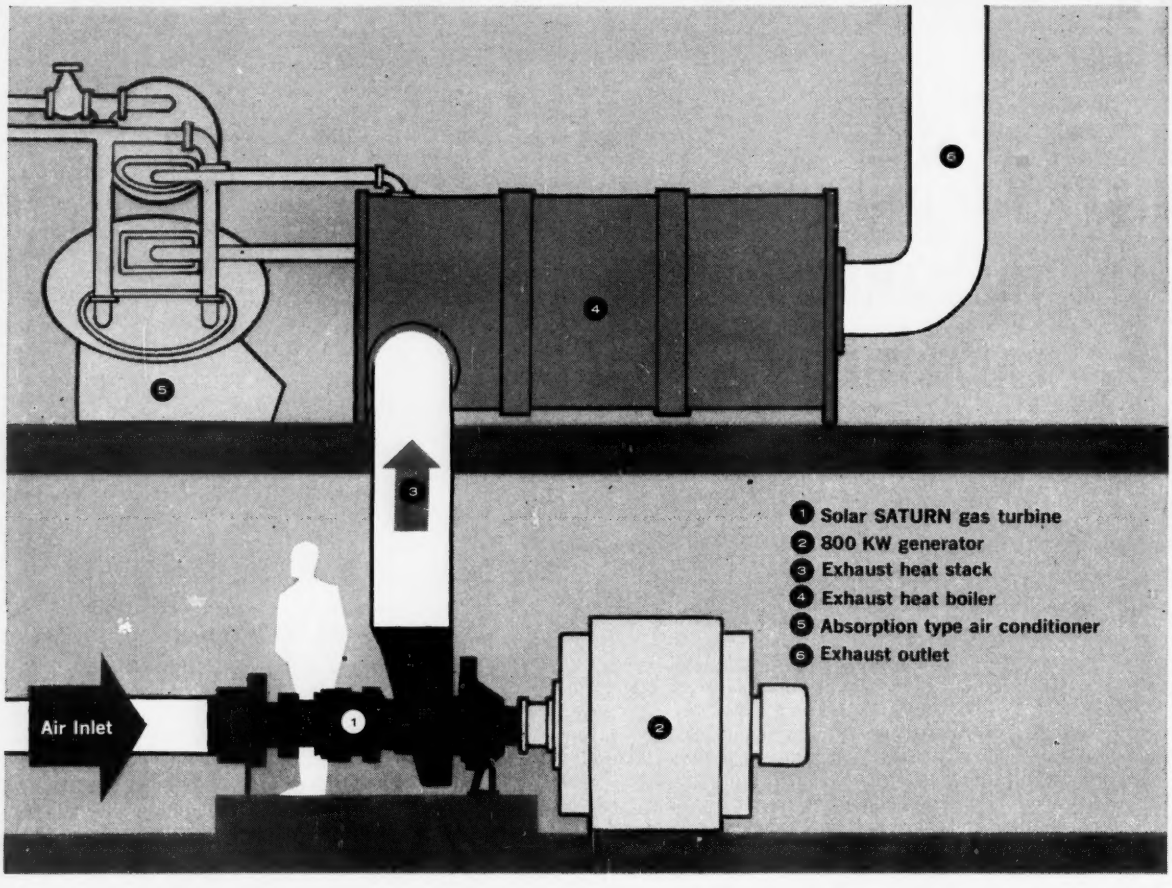
State_____

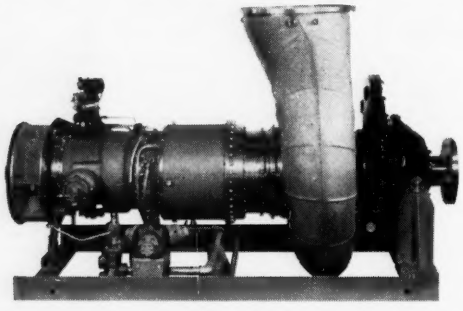


Solar gas turbine exhaust heat multiplies thermal efficiency

This unique system of efficient exhaust energy utilization illustrates one of the many advantages of Solar gas turbines. In addition to the turbine's main shaft power, exhaust gases can be put to work to multiply the thermal efficiency of the installation up to three times that of the prime mover alone.

In the typical system illustrated above, Solar *Saturn* gas turbines turn 800 kw generators, providing electricity for lighting and machinery. Turbine exhaust heat is passed through a boiler to provide steam for process or building heat and absorption air conditioning.

This installation with three *Saturn* engines produces 2400 kw of electrical energy and 16,150 lbs of steam per hour. The complete package fits in a 60 ft by 40 ft space. The turbines will run on gasoline, kerosene, diesel fuel and natural or manufactured gas.



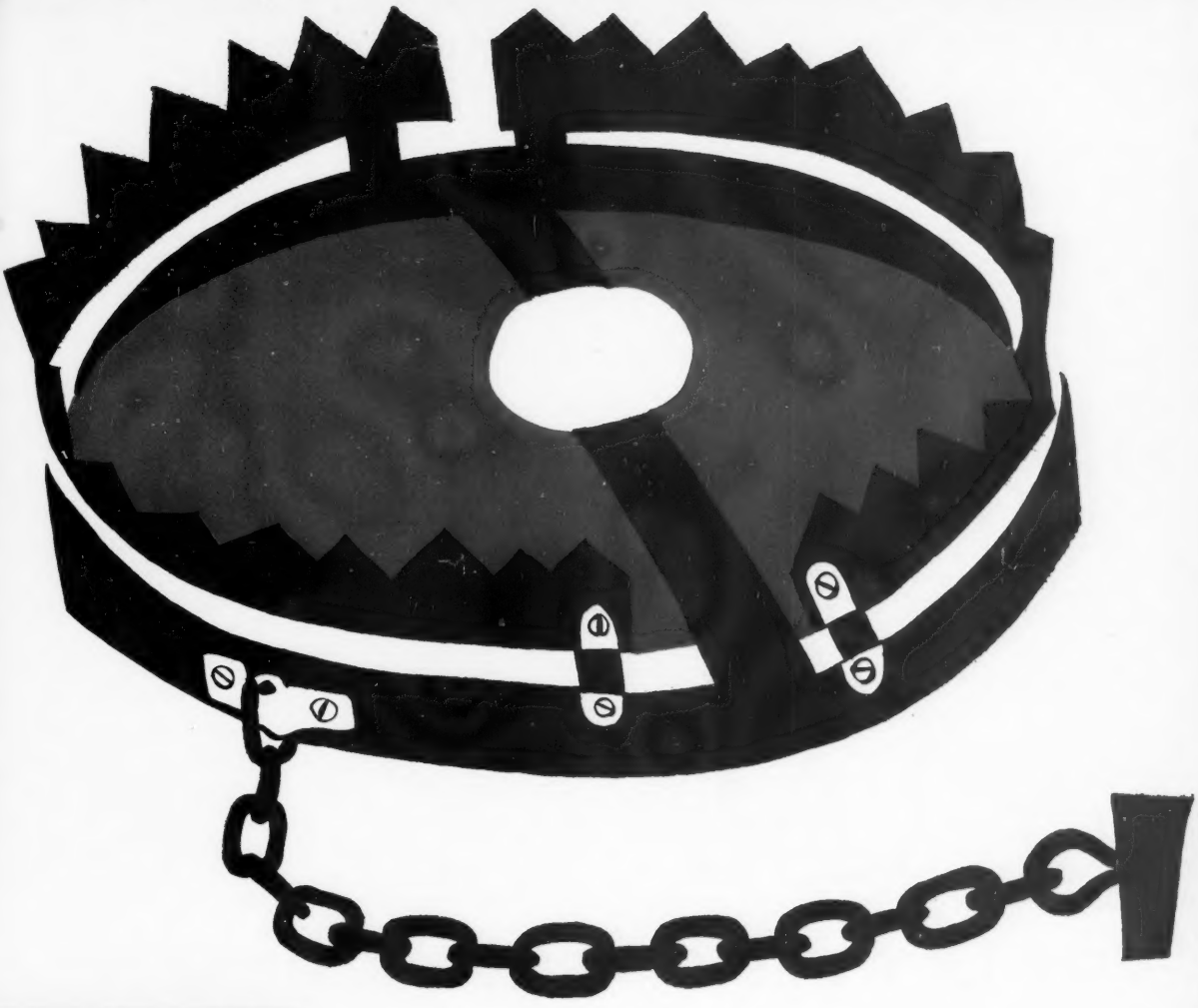
Exhaust heat utilization systems are easily adaptable to any job where electric power generation is needed, such as manufacturing and processing plants.

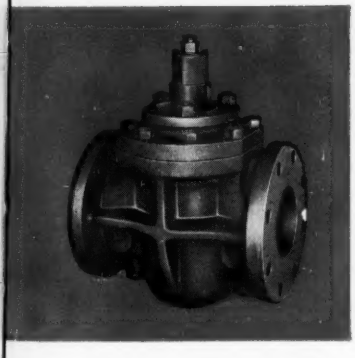
Solar gas turbines with their light weight, compactness, lack of vibration, long life and instant start capabilities are ideally suited for such jobs as electrical power generation, pumping, field and pipeline compression, oil well servicing, vehicle or marine propulsion.

Solar's family of gas turbines, from 50 to 1100 hp, are designed specifically for industrial use. Their design and manufacture are the result of over 15 years of experience. For further information, write to Dept. J-127, Solar Aircraft Company, San Diego 12, California.

SOLAR

A subsidiary of International Harvester Company





acts fast: There are times when a valve must shut off NOW! That's why you'll find Rockwell-Nordstrom valves in critical operations everywhere. With their smooth, fast quarter turn action and positive shut-off they're man's best friend in an emergency. It makes a lot of sense to use these same Rockwell-Nordstrom valves in all services—they cost no more. We'll be happy to send you complete information.

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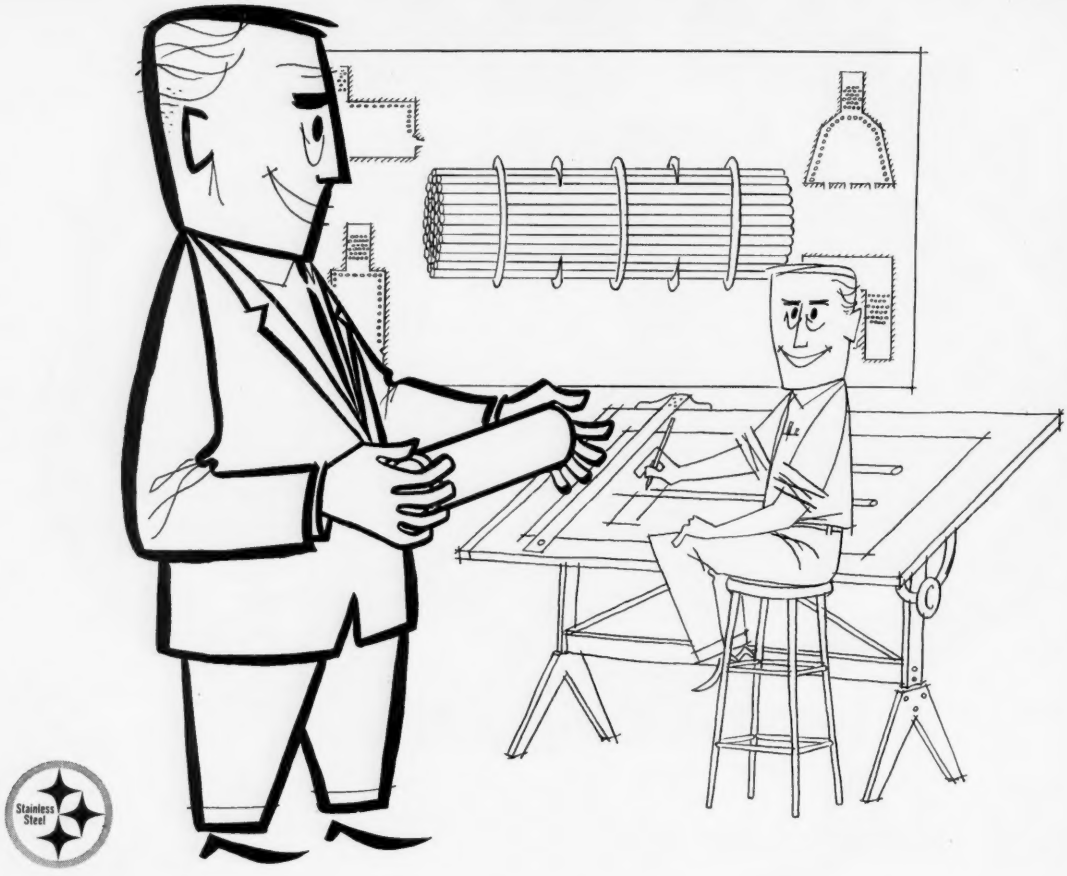


YOU LIFT DESIGN RESTRICTIONS, RAISE HEAT TRANSFER EFFICIENCY

with B&W Job-Matched Stainless and Alloy Steel Pressure Tubing

High pressures—severe temperatures—exposure to oxidation and corrosion—whatever extreme service conditions govern your heat transfer equipment, B&W can produce the right tube for the job.

To give you design freedom, B&W offers a complete selection of stainless and alloy steel pressure tubing. B&W will work closely with you in selecting the right grade and type — in matching the proper tolerances, properties, length, finish and heat treatment to your application. The result: tubing to "spec" that delivers maximum rate of heat transfer, provides easier fabrication and long service life.

Why not talk with B&W while your plans are on the drawing board? Just call your local B&W District Sales Office. Meanwhile write for Bulletin T-417. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

B&W

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA-1006-P

Seamless and welded tubular products, solid extrusions, rolled rings, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

COPPUS BLUE RIBBON PRODUCTS

Coppus Vertical Steam Turbine

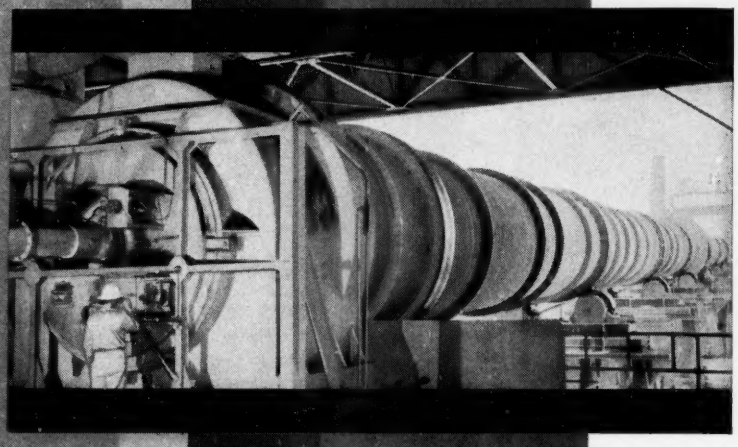
THE MARK OF QUALITY — There's no better test of a turbine's quality than performance. And the new, ruggedly designed, power-packed Coppus Turbines pass all performance tests with top honors! Small wonder. Coppus quality is literally designed and built into them. Their super stamina is the end-product of painstaking craftsmanship, finest materials and methods, thorough testing and control. Each truly deserves its Blue Ribbon . . . assurance of *complete* reliability.

Typical Coppus Blue Ribbon features are: *totally enclosed governor . . . totally enclosed and independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.* You get higher efficiency operation . . . less down time . . . lower maintenance costs.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. Send for Catalog 200. Get complete details on Coppus Turbines. Sizes from 1 HP to 250 HP. Write COPPUS ENGINEERING CORPORATION, 228 Park Avenue, Worcester, Mass. Sales Offices in *Thomas' Register*.

COPPUS
STEAM TURBINES

TRAYLOR FIRST



Why this 1933 first welded kiln could be the key to your company's profits in the 60's

For the simple well-proved reason that they're better, kilns of all-welded construction are pretty much "standard" today. Important to keep in mind: the standard was set by Traylor . . . builder of the first welded kiln in 1933.

A radical innovation a generation ago —but why so important now? First and obviously, it means that Traylor has the longest record of experience in this special kind of equipment.

More important still: It's merely one example of Traylor's coming up first with new ideas to meet changing needs. Benefits of other Traylor "firsts"— some dating before 1933, many since— are being reaped today throughout the industry, quite likely already including your own plant. Traylor built, for example, the first 60-inch primary gyratory crusher and the first large ball mill.

Today Traylor's proved capacity to pioneer sound innovations in kilns, mills and crushers is enhanced by expanded research capabilities and process know-how.

Up-to-date facilities and a long, impressive record of past "firsts" are a good combination of reasons to call on Traylor first when you're planning for efficient operation in the changing business climate of the sixties.

See Chemical Engineering Catalog for details and specifications.

Traylor — Fuller Company — General

TRAYLOR ENGINEERING & MANUFACTURING

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4492
TKA-15

YARWAY news briefs

from **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD
STEAM TRAPS STOCKED AND SOLD BY 270 LOCAL INDUSTRIAL DISTRIBUTORS

SOLID SUCCESS!

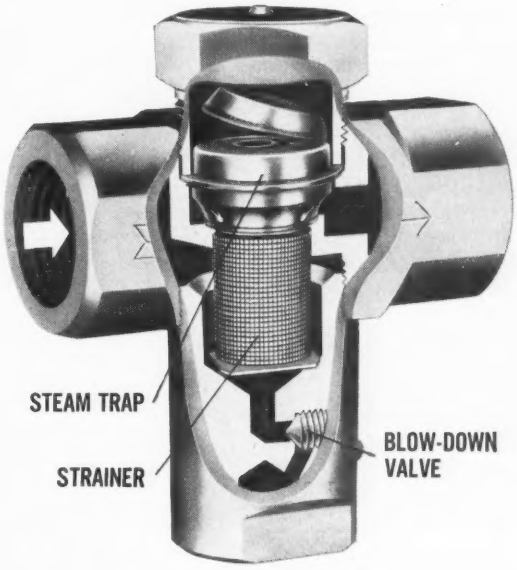
Yarway Series 130 Combination Steam Trap Wins Wide Approval

In chemical plants, refineries, other process plants, utilities, institutions—wherever condensate is handled in moderate amounts—this new Yarway Impulse Steam Trap is winning friends by the score.

Because it is a unique combination steam trap, strainer and blow-down valve, it offers these advantages no other steam trap can duplicate:

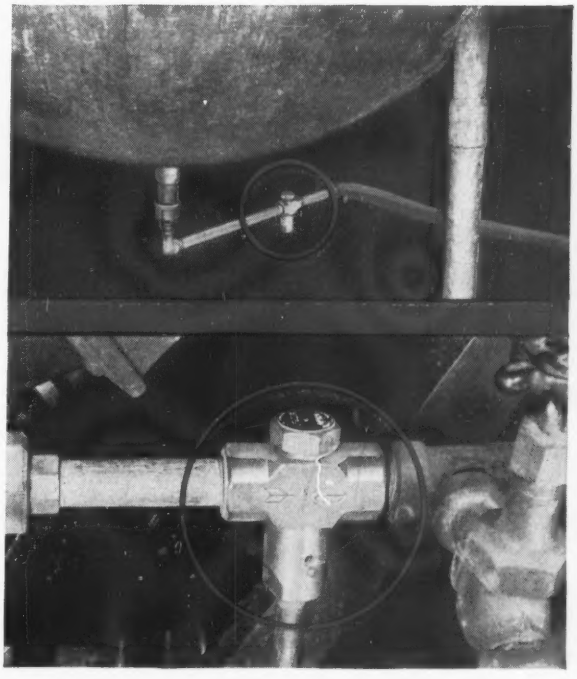
- IT SAVES SPACE—entire trapping hook-up requires no more space than a "T" fitting.
- IT SAVES MONEY—only one unit to buy and install, *up to 30% savings in time and materials.*
- IT SAVES WORK—easy to install, easy to maintain. Stainless steel construction. Good for all pressures 8 to 600 psi. Sizes ⅜" and ½".

Why don't *you* try a Yarway Series 130? Your nearby Yarway distributor can supply you—or write for Yarway Bulletin T-1743B.



CHEMICAL PLANT REDUCES CORROSION FAILURE —LIKES "COMPACT" DESIGN

For years, traps and strainers of iron and steel were subject to HCl and H_2SO_4 acid corrosion failure in this chemical plant. Installations lasted only a few months. Now Yarway Series 130 steam traps are solving this corrosion problem because the trap, strainer and blow-down valve are combined in *one stainless steel body*. In addition, trapping hook-ups on processing kettles are greatly simplified.



LAUNDRY OVERCOMES SPACE PROBLEM...GETS FASTER HEAT-UP, NO WATER HAMMER

Space was at a premium for steam trapping around the presses in this laundry, and also they couldn't get fast heat-up without water hammer. Yarway Series 130 combination steam traps solved all three problems to their complete satisfaction.

Darling Cast Steel Gate Valves

are made in regular and special compositions to match the exact operating conditions found in high pressure refining, pipeline, power plant, and process industry services.

The revolving double disc parallel seat and wedge construction, with plain "no-pocket" discs, prevents accumulation of line scale and sludge. Discs are free to revolve and either disc will work equally well against the pressure.

Built by skilled specialists under the watchful eye of continuous inspection, these cast steel gates will seat perfectly, release easily, operate surely . . . *you can depend on Darling.*

ENGINEERING SERVICE. To meet unusual operating needs, Darling staff engineers will be glad to work with you in developing special valves for your services. Write, wire or phone for detailed information.

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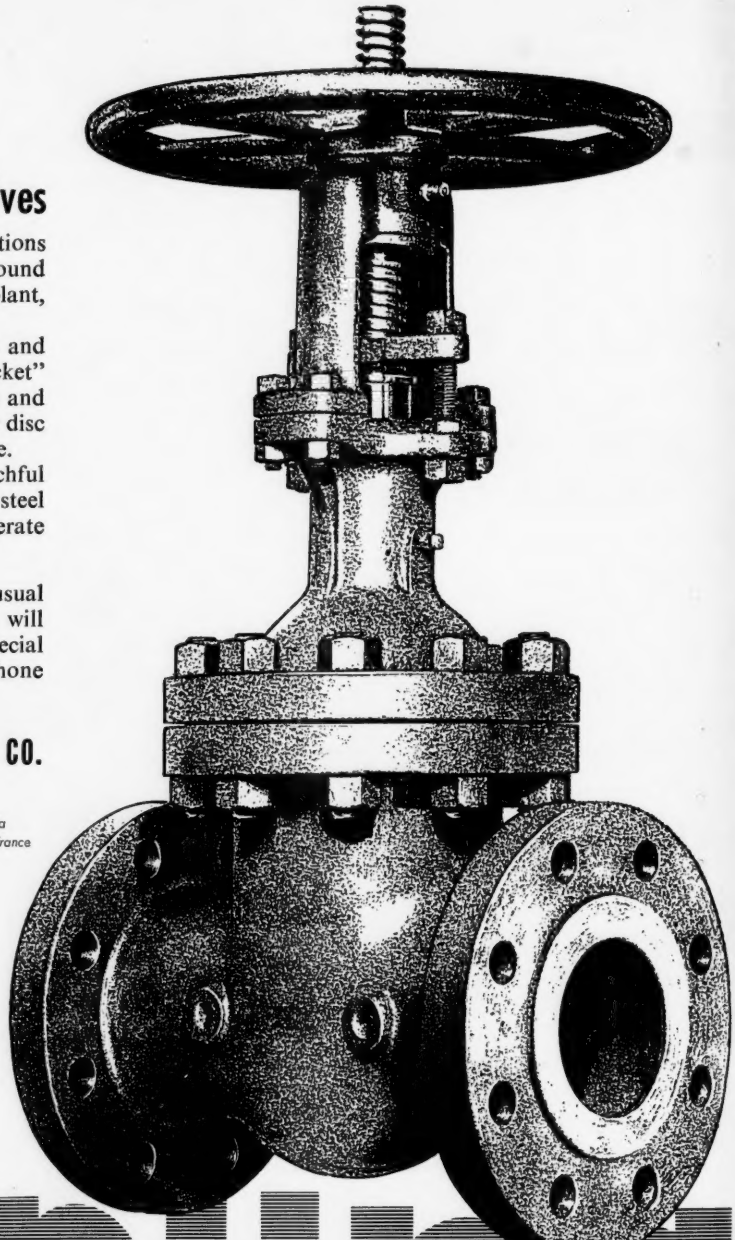
Williamsport 3, Pa.

Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario, Canada
Vannes Darling-France, 23 rue du Commandant Mouchotte, St. Mandé, France

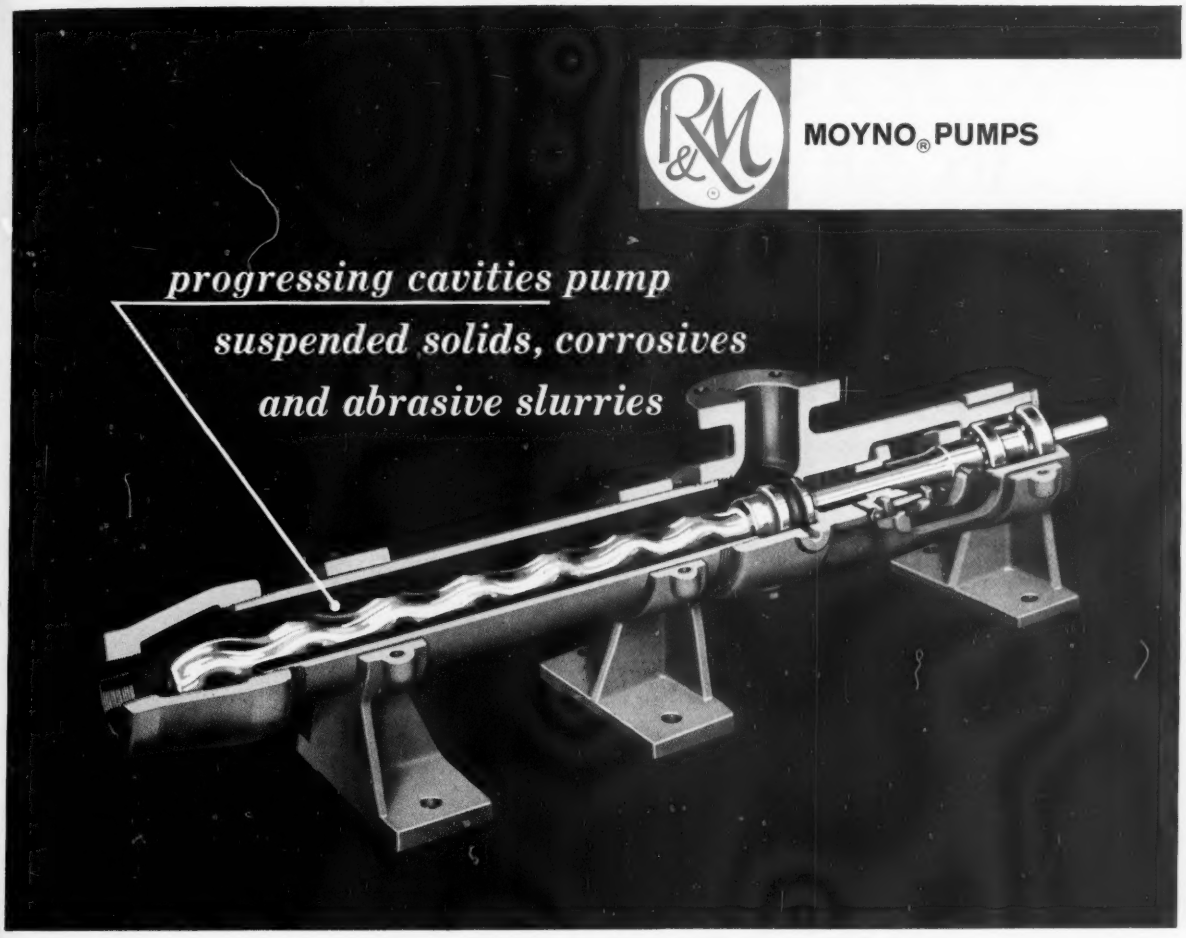


YOU CAN DEPEND ON

Darling

TRADE DARLING MARK

GATE • BUTTERFLY • CHECK • SPECIAL VALVES • FIRE HYDRANTS



MOYNO® PUMPS *turn problems into profits . . .*

Many materials, once considered "unpumpable," are now successfully handled by Moyno Pumps. Moynos have increased production and greatly lowered down-time on many jobs where they replaced rotary, centrifugal or piston type pumps which had run up prohibitive maintenance costs or failed completely. Moynos use a single moving pumping element . . . have no pistons, valves, high-speed impellers or other quick-wearing parts. The wide range of specially-resistant materials in which Moyno pumping elements are available assures exact job-tailored design for economical handling without excessive pump wear.

Moyno's unique "progressing cavities" move thin watery slurries, non-pourable abrasives, gnawing corrosives or suspended solids up to 1⅛" dia. The pump provides positive displacement . . . delivers uniform discharge without pulsation, agitation or turbulence. Moynos are available in many sizes, in capacities from 1/100 to 500 GPM and pressures up to 1000 PSI. Write today for new Bulletin 100-CE

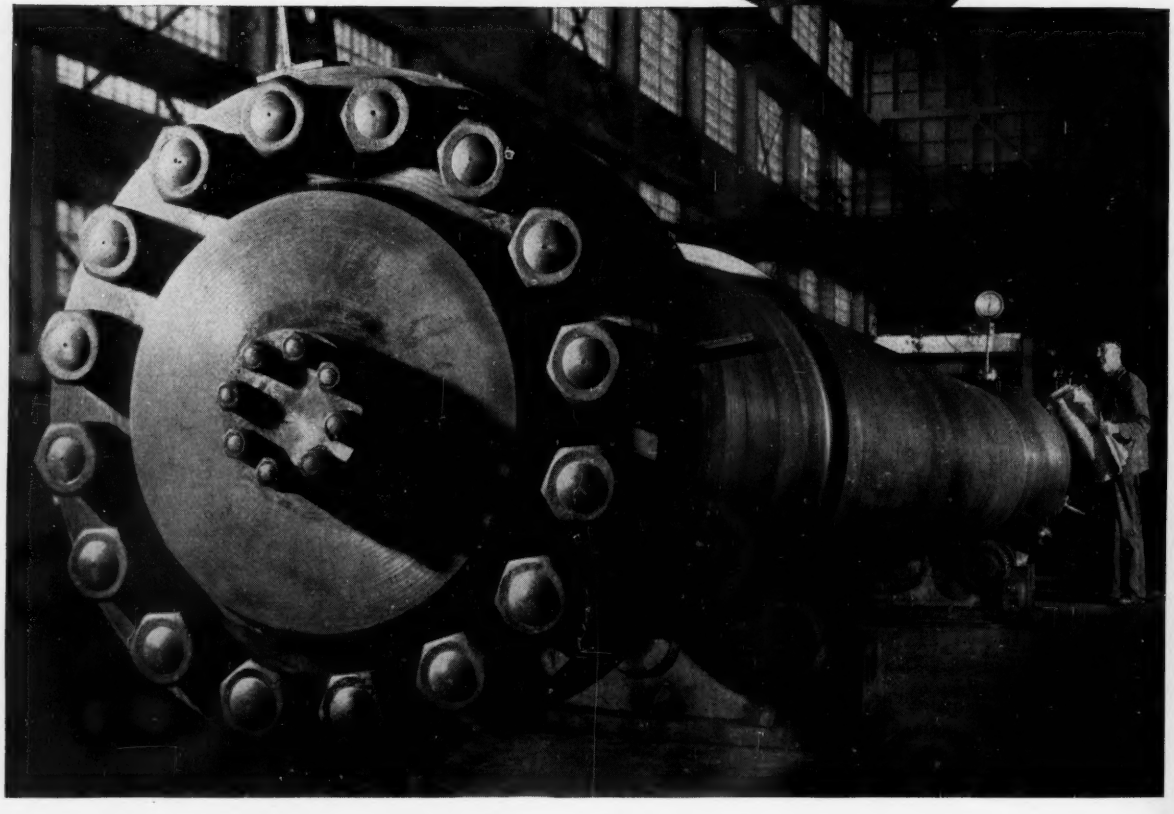
typical problem materials successfully handled by a MOYNO . . .

Acetates	Concrete Slurry	Paints
Acetic Acid	Copper Nitrate	Paper Pulp
Acid Mine Water	Creosote	Pickling Acids
Alcohol	Cutting Oil	Printing Inks
Alum (paper mill)	Cyanide of Potassium	Prunes
Aluminum Sulphate	Drilling Mud	Resin Plastic
Aromatic Hydro-carbons	Ferrous Sulphate	Salt Brine 3% to 30%
Asphalt	Fuel Oils	Sewage
Barium Sulphate	Fuming Sulphuric Acid	Shellac
Bichloride of Mercury	Gasoline	Shrimp
Boiler Feed Water	Glue	Soda
Bordeaux Mixture	Hydrochloric Acid	Starch
Carbon Dioxide	Impregnating Compound	Sugar
Carbonic Acid	Lacquers	Sulfurous Acid
Calcium Chloride	Lard	Tar
Caustic Soda (lye)	Latex	Turpentine
Cement	Match Head Compound	Varnish
Citric Acid	Molasses	Vinegar
Clay Slurry	Nickel Sulphate	Wood Pulp
Coffee Grounds	Nitric Acid	Yeast

ROBBINS & MYERS, INC., Springfield, Ohio

Moyno® Industrial Pumps • Fractional and Integral HP Electric Motors • Electric Hoists and Overhead Traveling Cranes
Propellair® Industrial Fans • R & M-Hunter Fans and Electric Heat • Trade-Wind Range Hoods and Ventilators
Subsidiary companies at: Memphis, Tenn., Pico Rivera, Calif., Brantford, Ontario.

We Make Them In All Sizes



The twin vessels at the top of this page weigh less than five tons each. Their maximum OD is about 22 in. Though slim little fellows, they are intended for relatively high pressures.

They are of course much lighter than that burly, rugged unit in the lower picture. There you have a vessel that is 30 ft long and weighs 25 tons. It's a reactor with a 36-in. OD, and with big, husky components throughout.

In the course of a year Bethlehem builds many other sizes and types of pressure vessels. Some exceed 150 tons in weight, finish-machined. But size is only one yardstick. Much more important is quality—precision engineering, precision materials, precision workmanship. These are the ingredients that make Bethlehem forged vessels so thoroughly dependable, even under the most exacting conditions.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

Steel
for strength
... economy
... versatility

BETHLEHEM STEEL

BETHLEHEM STEEL

"Made OF Stainless Steel ...Made BY Jenkins"

Write the COMPLETE SPEC for an extra-measure of service

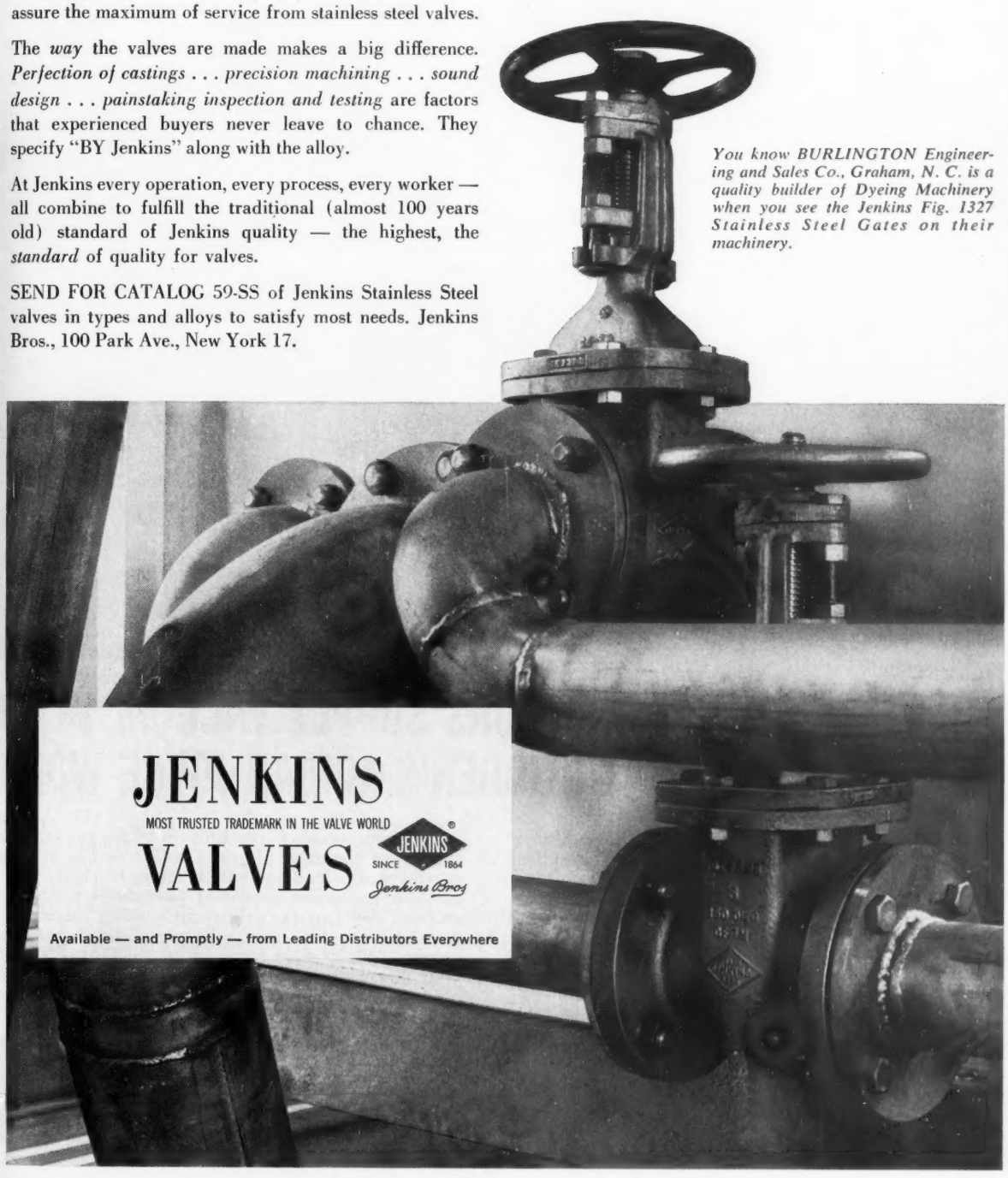
Of course the metal, the alloy, is important when applications require stainless steel valves. But the specification for a suitable alloy is only half the specification needed to assure the maximum of service from stainless steel valves.

The *way* the valves are made makes a big difference. *Perfection of castings . . . precision machining . . . sound design . . . painstaking inspection and testing* are factors that experienced buyers never leave to chance. They specify "BY Jenkins" along with the alloy.

At Jenkins every operation, every process, every worker — all combine to fulfill the traditional (almost 100 years old) standard of Jenkins quality — the highest, the *standard* of quality for valves.

SEND FOR CATALOG 59-SS of Jenkins Stainless Steel valves in types and alloys to satisfy most needs. Jenkins Bros., 100 Park Ave., New York 17.

You know BURLINGTON Engineering and Sales Co., Graham, N. C. is a quality builder of Dyeing Machinery when you see the Jenkins Fig. 1327 Stainless Steel Gates on their machinery.



JENKINS

MOST TRUSTED TRADEMARK IN THE VALVE WORLD

VALVES

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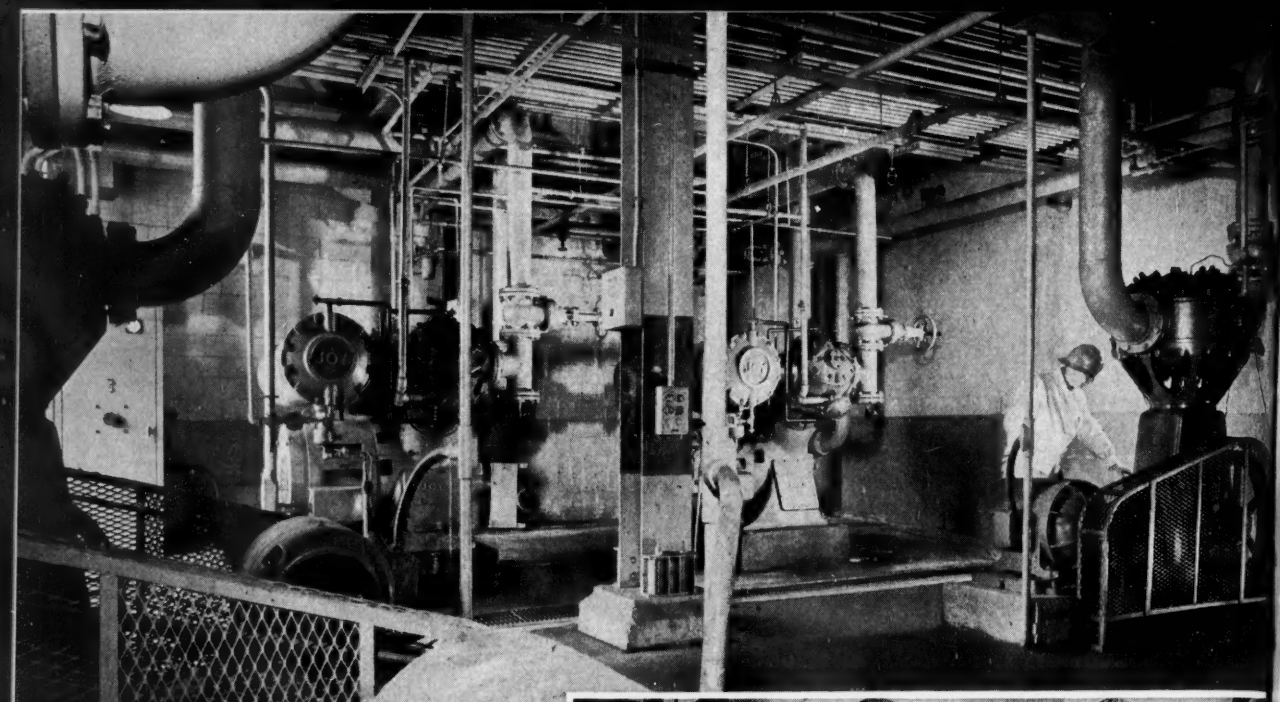

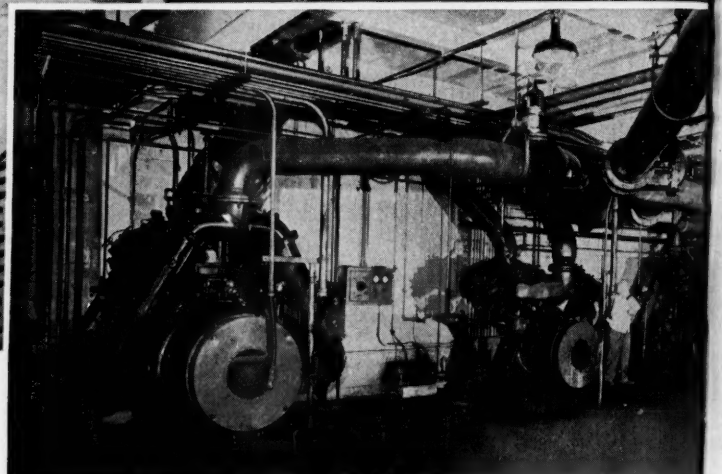

Glidden Company's Adrian Joyce Works at Baltimore, Md., uses 7 Joy WG-9 Vacuum Pumps, 3 WN-114's and 4 WN-112's for all plant requirements.

FOURTEEN JOY COMPRESSORS SUPPLY VACUUM, PLANT AND PROCESS AIR AT GLIDDEN'S ADRIAN JOYCE WORKS

The Glidden Company's modern Adrian Joyce Works relies on fourteen Joy compressors to provide all of the air requirements, ranging from 25" vacuum service to 30 pound process air and 100 pound plant air. The plant converts ilmenite to titanium dioxide by the sulfate process, which involves the use of sulphuric acid as a reducing agent. During the three years the plant has been operating, all fourteen Joy machines have stayed on the line with a minimum of downtime for maintenance.

Joy compressors are built for the rugged duty typical of chemical plants. Heavy casings and conservative rod loadings enable them to easily handle air and gases for extended periods of continuous service. Joy can provide reciprocating machines in standard or oil-free constructions, axial and centrifugal compressors in sizes from 15 to 15,000 hp. Consult your Joy representative whenever you need a compressor. For complete information on the Joy line, write for Bulletin 2561-11.

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Top news stories and what they mean to CPI technical decision-makers

Chementator

First repeat of computer control slated for big Ohio ammonia plant

Upstream 1,100 miles from Monsanto's computer-controlled ammonia plant at Luling, La. (*Chem Eng.*, Nov. 14, 1960, p. 110), Allied Chemical Corp. is preparing to install a similar computer in its South Point, Ohio, ammonia plant.

Older and bigger than the Monsanto facility, the plant uses Allied's version of the Haber-Bosch process. To up its 900-ton/day production (Allied has opened up several bottlenecks in the plant before), the firm has now turned to computer control. It will try out TRW Computer's RW-300, the same unit used by Monsanto.

For several reasons, observers will follow the new Allied installation with interest:

- The plant represents more total investment than that of previous plants selected for computer control, so payout should be easier.
- Other than instrumentation, no plant modification is needed for the application.
- Allied has two other large ammonia plants. If successful at South Point, computer control will probably be considered for these.

Sensing over 300 process variables, the RW-300 will perform an economic optimization routine on the internally stored mathematical model of the plant. Then it will reset operating points for over 60 variables. Though unconfirmed by Allied, plant's total investment of about $30 million will require less than 2% increased return, before taxes, to pay out the $300,000 computer project in one year.

Soviet technology coming to U. S. via unique exchange agreement

National Patent Development Corp. has accomplished one-half of its original objective of starting a two-way flow of industrial technology between the Soviet Union and the U. S. (*Chementator*, July 24, p. 62). The firm has just received an exclusive license to about 60 Soviet patents. (To date, however, it has failed to interest the Soviets in buying any U. S. patent rights.)

Fields covered by the precedent-shattering agreement include electronics, ultrasonics, medical instruments and machine tools. Patents, described by company president Jerome Feldman as "the cream of Soviet technology," will now be available to U. S. firms on a royalty basis.

The company's agreement with Amtorg (the Soviet trading corporation) will work like this: a U. S. licensee will pay National Patent Development the royalty, which will then be split with Amtorg on a fixed percentage basis. The company estimates that if it finds U. S. customers for just half of the patents, it will generate $50-100 million in yearly revenue for the Soviet Union, more than the present total volume of trade between the two countries.

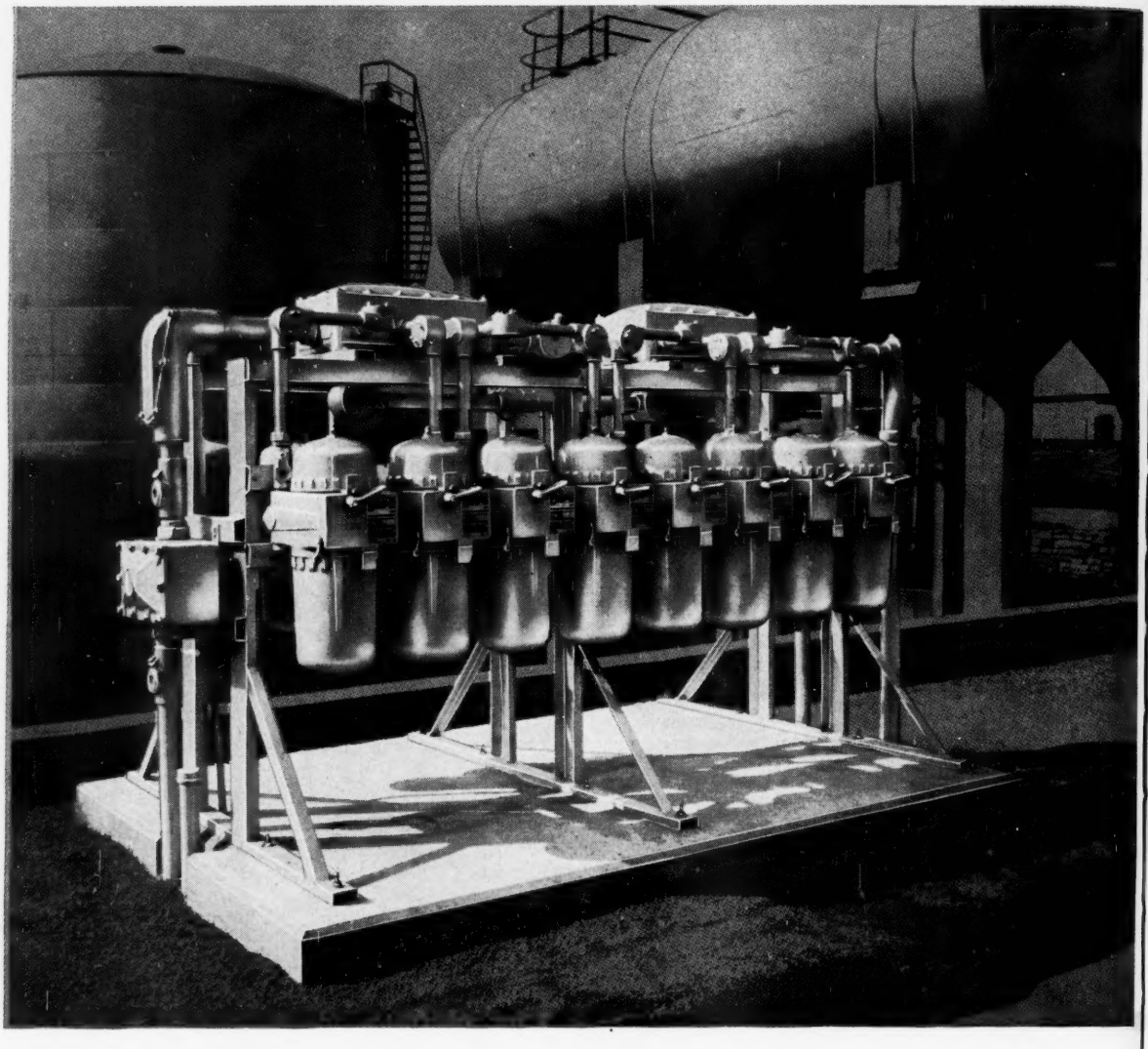
Among the specific subjects covered by the Soviet patents are microwire drawing, transistors, thermoelectric elements, diffusion welding and fine-wire encapsulation.

Claims of high yields spur interest in liquid-phase phthalic process

Speculation about the recently announced Cowles liquid-phase phthalic anhydride process (*Chementator*, June 12, p. 85) is being stimulated by a new set of cost estimates. According to informed sources, process licensor Catalytic Construction Co. is claiming that the route can produce phthalic for 8-9¢/lb, including depreciation.

This cost is based on yields of up to 1.25 lb. phthalic per pound of *o*-xylene feed. These yields, however, have been obtained only in pilot operation, and remain to be proved on a commercial scale. The estimated cost assumes a value of 5¢/lb. for 95% *o*-xylene, which is actually slightly higher than the going rate.

Capital cost for the process is claimed to be low, even though there are problems with construction materials that aren't encountered in vapor-phase processes. Cowles' route consists of



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a two-stage oxidation; first stage using air and the second using nitric acid. The nitric as well as the first intermediate are both corrosive.

A manufacturing cost of sales of 8-9¢/lb. would be attractive since phthalic is now selling around 19¢/lb. The only commercial liquid-phase process now in operation is Amoco's unit at Joliet, Ill. This facility oxidizes a xylene mixture, however, and produces all three phthalic acids. Although no cost data have ever been revealed, Amoco's costs must also be low since the company was prompted to cut the phthalic price to 17¢ when the market was about 21¢/lb. Unlike the Cowles process, however, Amoco's route isn't available for licensing in the U. S.

Besides the possible effect that the Cowles process could have on the turbulent phthalic business, it is also sure to stimulate interest in *o*-xylene, as ortho struggles to woo producers away from traditional naphthalene feeds.

Dow Chemical's Plaquemine, La., ethylene unit suffered a $200,000 fire last month when a safety disk ruptured on a fractionating column; escaping vapors were ignited by an unknown cause. Fire then spread through the foamed styrene insulation. Unit was out of production about four weeks.

Polymerize nylon in mold to achieve large, complex shapes

The Polymer Corp., Reading, Pa., has developed a new approach to an old problem: how to mold large, complex nylon parts. Company's method avoids the problems of conventional processes by polymerizing the nylon in the mold.

Polymer Corp. hopes its method will aid nylon in making further inroads into metal markets for parts such as bushings and gears. Penetration of these markets has been restricted to date by limits on the size of parts that can be made in conventional equipment.

Nylon is especially difficult to mold because of the need for high pressures and close temperature control. Unlike most other thermoplastics, nylon lacks a semisolid state before it liquefies. Nylon-6, for example, is solid around 406 F., and becomes a soupy liquid at 410 F.

In the U. S., most large complex shapes are formed by first extruding a simple block, then machining to final form—a costly procedure. Development of improved techniques is complicated by a sticky patent situation, in which many firms are trying to avoid the many basic patents held by Polymer Corp.

In Europe, the patent situation is more fluid, and advanced work is being done by firms such as Germany's Continentale Metall, GmbH., Frankfurt; Schroeder und Stadelmann, Oberlahnstein; and Holland's Allgemeene Kunstzijde, Arnheim.

Although details about European methods are unavailable, Continentale's process is believed to draw upon that firm's experience with metal forging. Nylon is probably heated to 150-160 C., then forced in the still-solid state into a mold under tremendous pressure.

High-pressure equipment is expensive, however, which is why Polymer Corp. devised its "monomer casting" technique. Another approach utilizing the liquid phase has been developed by Allied Chemical, which uses a centrifugal casting process for limited applications.

Humble Oil & Refining is expanding capacity of its Baytown, Tex., polyolefin unit to 60 million lb./yr. Speculation is that the addition will enable Humble to produce polyethylene in addition to the polypropylene currently being turned out. Plans call for increasing capacity to 80 million lb./yr. by the end of 1962.

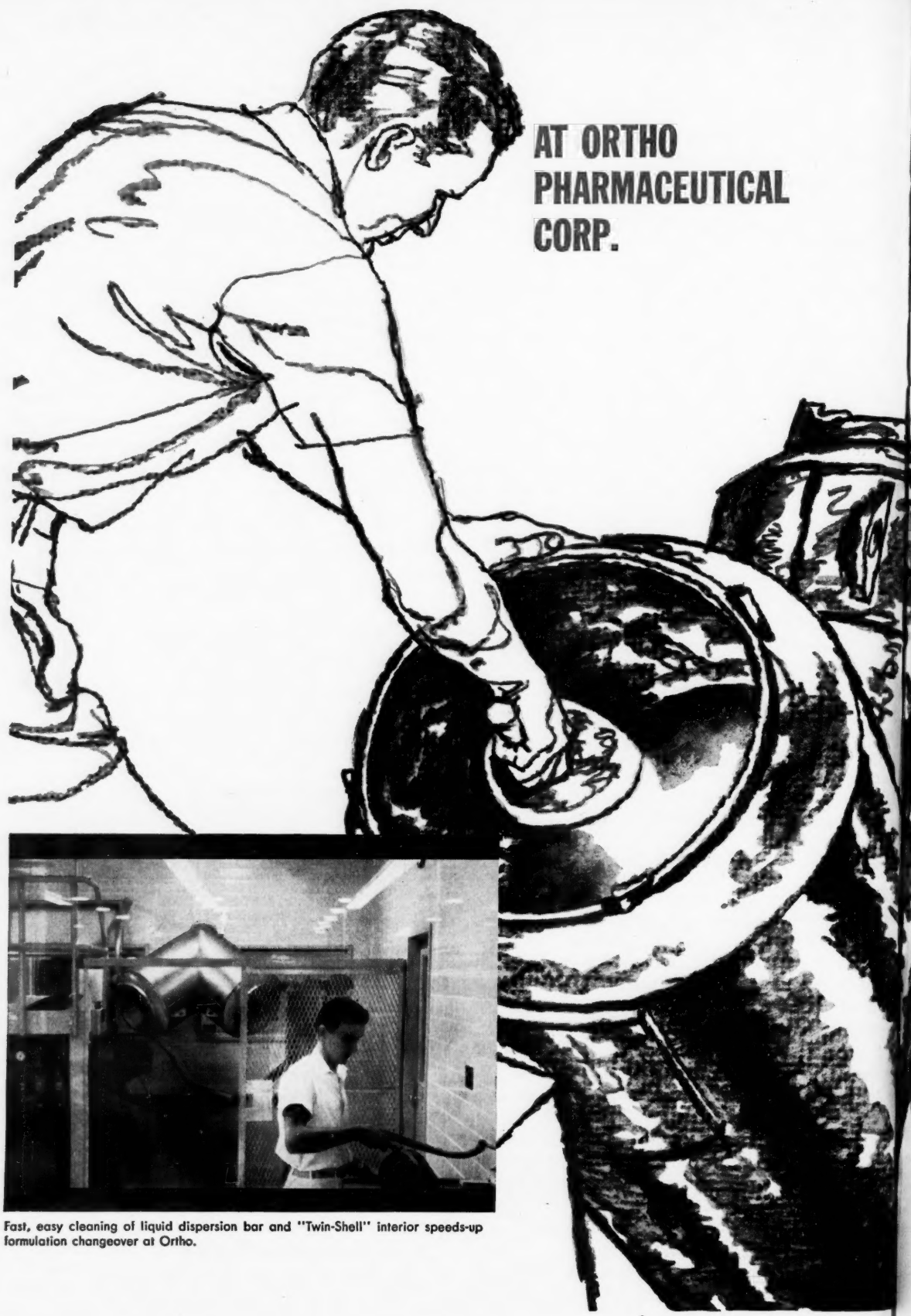
Needed: a sodium borohydride market to balance lower price

Metal Hydrides, Inc., only U. S. producer of sodium borohydride, is trying to attract new users of the material with a lower price tag. But the move, which cut the price from about $20/lb. down to $8/lb., still leaves many asking: Can commercial markets absorb present capacity?

Sodium borohydride facilities were built in anticipation of a jet engine fuel market that never materialized. With an existing capacity of something under 1 million lb./yr. at Beverly, Mass., Metal Hydrides has just purchased the government's 2-million-lb./yr. plant at Danvers, Mass.

Despite the 60% price reduction, commercial applications for the material are not ob-

(Continued on page 58)



Fast, easy cleaning of liquid dispersion bar and "Twin-Shell" interior speeds-up formulation changeover at Ortho.

P-K LIQUID-SOLIDS BLENDER GRANULATES TABLET FORMULATIONS IN A SINGLE STEP

PRE-BLENDS, DISPERSES, GRANULATES

A 10-cubic foot Liquid Solids "Twin-Shell"* Blender pre-blends dry tablet powders, disperses liquids into solids, and granulates tablet formulations in a single production step for Ortho Pharmaceutical Corporation, Raritan, N. J. It replaces equipment requiring multiple step processing.

The P-K Liquid-Solids Blender was purchased, according to John Colligas, Director of Pharmaceutical Manufacturing, "as a result of pre-testing, which demonstrated the unit's ability to precisely blend and granulate our material as well as provide versatility and close quality control. We need these features because of the varied formulations in our new line of tableted products."

P-K PRE-TEST RESULTS CONFIRMED

Before installation, specially selected formulations prepared by Ortho were tested in the Liquid-Solids Blender at the P-K Pre-Test Laboratory in East Stroudsburg, Pa. These results then formed the basis for more extensive testing of the blender at the Ortho Plant. Here, tests centered mainly around the precision blending of dry materials and uniform dispersion of liquids and solids.

In a dry blending test, research engineers put 0.5 gms. of activated charcoal powder into 29 lbs. of Ferrous Calcium Citrate-with-lubricant mixture, through the charge openings of the P-K Blender. Following ten (10) minutes of operation, one-pound samples were taken from each of the three openings and subjected to microscopic examination. *Counts showed total dispersion had been achieved.*

In a similar liquid-solids test, 50 pounds of powdered lactose were pre-blended. Then, a dilute solution of methyl violet (0.1 gm./1,000 gm.), in 300 gm. increments, were poured in. After blender operated for ten (10) minutes, the powder was removed. *Inspection showed a more homogeneous wetting than that achieved in tests of other equipment.*

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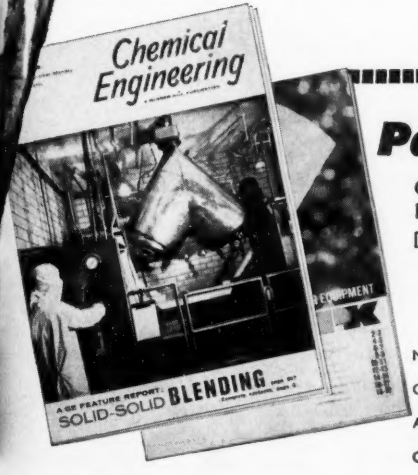

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☐ NEW REPORT ON SOLID-SOLID BLENDING. A 23-page cover article from *Chemical Engineering*, Aug. 8, 1960. Discusses blending theory, practice, equipment and economics.

☐ NEW P-K PROCESS EQUIPMENT CATALOG NO. 16-P. A 20-page bulletin, covers P-K pre-test services, lab and production blenders, vacuum tumble dryers, packaged resin-distillation pilot plants, heat exchangers.

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vious. For example, it can be used as a selective reducing agent for various organic materials; e. g., hydrogenation of carbonyl groups in cellulose, to stabilize the brightness of bleached wood pulp. But, say paper men, borohydride would have to be used at a rate of 10-20 lb. ($80-160) per ton of pulp. Since bleached pulp sells for only $160-180/ton, sodium borohydride would have to drop to $2/lb. to receive serious consideration.

Borohydride can also generate high-purity hydrogen via reaction with water over a catalyst. Thus it could be used to foam rubber and various plastics. On a gas-volume basis, new prices put sodium borohydride in the same range as other commercial (usually nitrogen-producing) blowing agents. But its water sensitivity is a big drawback, according to one rubber industry spokesman. Unlike entrenched products, the borohydride must be protected from moisture.

Refractory metals get more capacity; now they wait for bigger markets

The problem of over-capacity isn't limited to the chemical industry; it's plaguing refractory metals, too.

Among the latest capacity additions: Haynes Stellite Co., division of Union Carbide, has a new facility at Kokomo, Ind., that is claimed to be the most completely integrated plant for producing refractory metals (columbium, tungsten, molybdenum, tantalum, vanadium and chromium). Temescal Metallurgical Corp., Berkeley, Calif., has just started up the biggest (1-million-lb./yr. capacity) electron-beam melting furnace for refractory metals. Du Pont also entered the field recently with a big columbium processing facility at Baltimore, Md.

Of the six refractory metals, the plight of columbium is the most serious. Not too long ago, it had been touted as a real "comer." Production, which was only 56,000 lb. in 1958, climbed to about 300,000 lb. last year.

Most of this output, however, was taken by Pratt & Whitney for use in heat exchangers for the nuclear aircraft project. Now that the project has been drastically curtailed, the columbium market has just about dried up. Main hope for reviving interest in the metal rests on a possible reactivation of the nuclear aircraft program and the potential use of Cb in blades for high-temperature jet turbines. Metal cost (about $50/lb.) isn't too great a factor because most of the Cb goes to the government.

Other refractories haven't experienced the reversal that columbium has, but the growth hasn't been coming as fast as some had predicted. One market research manager notes glumly that "there just aren't any new markets for these metals. I won't say that new uses aren't coming, but the market certainly is confused today."

Halide-free catalyst eliminates hydrocracking during reforming

Houdry Process Corp. has just announced a new hydrocarbon reforming catalyst. Main feature: no halogen, in contrast to most platinum reforming catalysts that incorporate a halogen such as chlorine.

By eliminating chlorine, Houdry reforms hydrocarbons without the breaking of carbon-to-carbon bonds (hydrocracking) commonly experienced with halogenated catalyst. Some industry observers believe that this characteristic will enable users to reform lighter feedstocks than now possible. Most Houdriforming units, for example, now operate on feeds with an initial boiling point no lower than 200 F.

Since there is little hydrocarbon breakdown with the new catalyst, yields of gasoline from low-boiling material would be higher than could be obtained with conventional catalysts. An additional bonus is that reduction of hydrocracking raises purity of hydrogen off-gas from the reformer since there are few light hydrocarbons mixed with it.

All that Houdry will say about commercial application of the new catalyst is that it's being used in some Japanese reformers, producing "high yields of gasoline" with "high octane number." The company will not say at this time what economic advantage, if any, the catalyst offers.

Trio of smog-analyzing devices joins battle against air pollution

Growing national concern over air pollution has sparked a rash of developments in air sampling and analysis. Although California is the only state moving actively to stamp out atmospheric pollution from practically every source, deepening palls of smog and haze hanging over many cities are certain to stimulate legislation.

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Researchers working on the smog problem agree that an important weapon in the battle would be an analyzer that would continuously monitor the atmosphere to record the type and quantity of contaminants present. Three new devices are a step in that direction:

• A special infrared spectrophotometer, built by Beckman Instruments, can be used to identify smog-producing chemicals such as hydrocarbons, nitrogen oxides and ozone. To be used by the Stanford Research Institute, the device works at the parts-per-billion level.

• Contamination from SO_2 is the target of another monitor that works by drawing air through a tube containing a radioactive reagent. Radioactivity, in direct proportion to the SO_2 present, is carried away in the gas sample. Then the radioactivity is measured and related to the contamination level. Unit, developed by Tracerlab, Inc., is now being used in San Francisco.

• General Electric has come up with a device, called a condensation nuclei detector, that can gage smog-producing materials in parts per trillion. Unit identifies gases by combining them with other substances to produce a solid or liquid. These submicroscopic particles grow until they are large enough to scatter a light beam. Measured electronically, the light scattering indicates the nuclei concentration in a given sample.

More details on the new solid-fueled rocket developed by United Technology Corp. (Chementator, July 10, p. 62): motor contains 850 lb. of propellant, has a specific impulse of 275 under space conditions, maintains a thrust of 6,000 lb. for over 30 sec.

First attempt at engineering unity seems doomed—at least for now

If any engineers had harbored hopes that the engineering profession would someday have a unified voice comparable to the American Medical Assn., they are seeing this dream rapidly vanish. The first step in a program that might have created such a body—the proposed merger of the Engineers Joint Council (EJC) and the Engineers Council for Professional Development (ECPD)—seems sure to be voted down by the member societies.

A parallel move towards closer professional cooperation—the entry of the National Society of Professional Engineers into ECPD—has also been shelved, primarily for tax reasons. NSPE is taxed as a lobbying group, while ECPD has the tax-exempt status of a nonprofit group.

To effect the merger of EJC and ECPD into an American Engineers Assn., first proposed early last year (*Chementator*, Feb. 22, 1960, p. 53), requires a two-thirds vote of both organizations. Such a majority has already been obtained in EJC, but it appears that the ten-member, ECPD will vote the proposal down. Although two ECPD members—the Institute of Radio Engineers and National Council of State Boards of Engineering Examiners—have yet to vote, most observers believe that both will say no. This will leave ECPD deadlocked with five yeas and five nays (AIChE is among those in favor of the merger).

Leader of the nay-sayers is the American Institute of Electrical Engineers. It feels that the merger would not square with its "functional plan," first proposed five years ago. This plan asserts that engineering problems should be split up among the three major groups: ECPD handling educational matters, EJC coordinating technical questions and NSPE tackling other "professional" subjects. In this way, the member societies maintain their traditional autonomy.

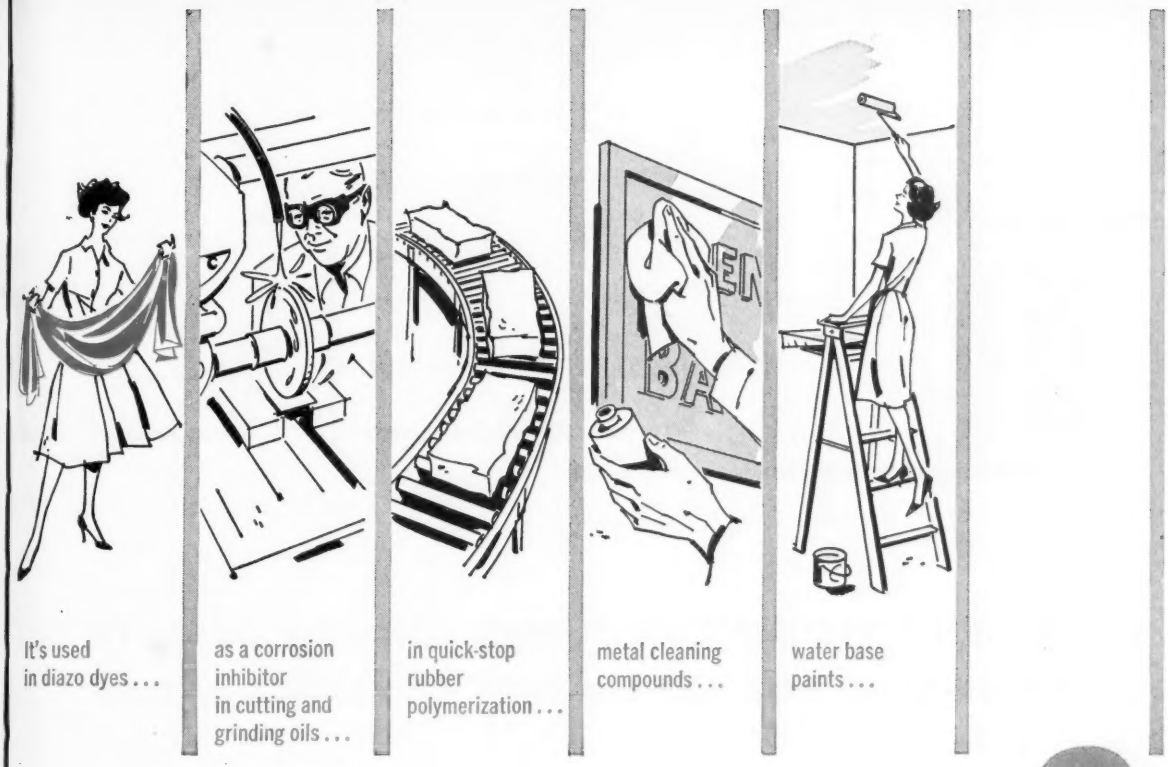
AIEE feels that its functional plan is now in effect—although not as a formally stated policy. The society believes that another "supergroup" would confuse the now relatively clean-cut lines of responsibility.

First commercial quantities of rhenium-tungsten alloy are being produced by Chase Copper & Brass via powder metallurgy processing. One potential use for the alloy is in thermocouples that would function up to 5,400 F.

Research and development briefs

An insecticide, specific to lettuce-eating caterpillars, that kills appetite has been developed at the University of California (Davis). Material is thought to act as an antimetabolite—a chemical that replaces some vital enzyme or hormone in the insect's metabolic cycle. In this case, the caterpillar evidently feels that its stomach is full, but is actually starving to death. Material, which is still experimental, is not toxic to humans, creates no residue problems.

For More Industry & Economic News . . . p. 62



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Potassium Chloride (KCl)	0.002%
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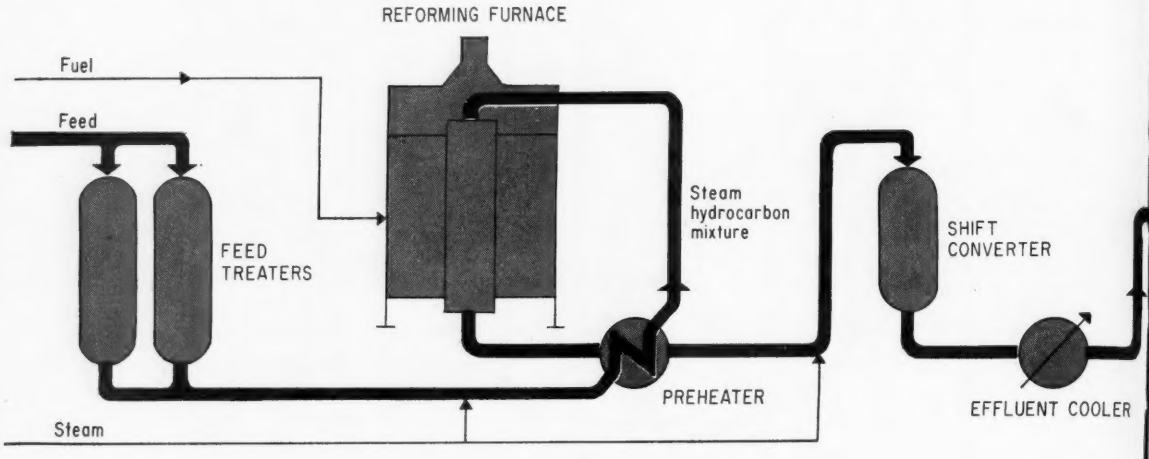


HYDROGEN CONSUMPTION CLIMBS FOR NEW HEIGHTS AS DEMAND FOR GENERATING FACILITIES GROWS

Engineering and construction firms cite unprecedented interest in hydrogen. Steam reforming of natural gas is seen as the most probable route to additional capacity.

The predicted upsurge in hydrogen consumption, which may reach a trillion cu. ft./day by 1970, was signaled emphatically by the announcement that Tidewater Oil Co. will install 50 million cu. ft./day of hydrogen-generating capacity in its Avon, Calif., refinery.

Significantly, refineries commonly have excess hydrogen derived from catalytic reforming; the need for supplemental hydrogen stems from increased demand for motor fuels and decreased heating oil requirements. To upgrade stocks to meet this market pattern, hydrogen is needed.

Current hydrogen consumption is dominated by ammonia and methanol production but with the advent of hydrodealkylation, hydrocracking and hydrodesulfurization, refinery consumption is rapidly closing the gap.

Interest in hydrogen production has intensified competition among the major U.S. engineering and construction firms that offer hydrogen facilities either as packaged plants or as part of a larger complex. Almost all report that inquiries concerning hydrogen-producting equipment have skyrocketed in the past six months.

Indicative of this interest: Esso Research and Engineering is reportedly seeking an installation geared to produce a fantastic 500 million cu. ft./day of hydrogen.

▶**Where Is It All Going?**—Considerably more hydrogen is produced than is consumed today in the U.S. Almost two-thirds of the hydrogen pouring out of catalytic reforming units is burned as fuel, simply because no process has been developed to economically purify some of the hydrogen streams.

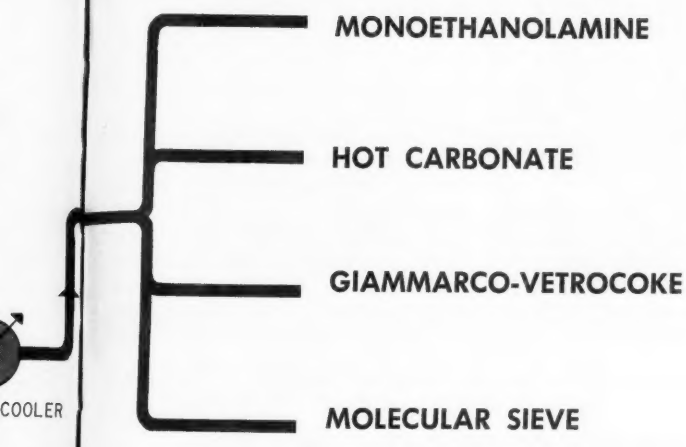
Prior to the introduction of hydrodealylation, hydrocracking and hydrodesulfurization, hydrogen consumed in refineries was largely used for purification, such as preparing feeds for catalytic reforming, and removing sulfur and nitrogen from middle distillates. Demand in this area is growing rapidly, as shown at right.

Hydro processes gulp hydrogen in huge quantities. A typical dealkylation plant making benzene and naphthalene consumes 1,300-1,900 cu. ft. per barrel of toluene feed, while 1,000-1,800 cu. ft. are needed per barrel of oil charged to a hydrocracking unit.

Steadily growing as consumers of hydrogen are synthetic ammonia and methanol production plants, and Oxo-process alcohols and aldehydes. Among other uses of hydrogen on a large scale: hydrogenation of organic intermediates, fats and oils; reduction of metallic ores; metal treating; use as a liquid for rocket fuel.

▶**Which Way to Hydrogen?**—The omnipresence of hydrogen in various refinery streams in association with many different contaminating materials means that no single process is suitable for treating a stream to obtain relatively pure hydrogen. Frequently, the hydrogen is mixed with hydrocarbons that cannot be separated economically on a commercial scale, although research is intensive in this area.

By and large, additional hydrogen will be made available by one of five routes that currently have some commercial importance. These include steam reforming, partial oxidation, water gas pro-



duction, electrolysis and off-gas treatment (*Chem. Eng.*, Dec. 12, 1960, pp. 161-166).

Of these, steam reforming and partial oxidation have perhaps the greatest potential for providing future hydrogen capacity. Partial oxidation derives its strength principally from overseas applications, while steam reformation has the edge in the U. S. because of the wide availability of natural gas.

The growth of steam reformation in hydrogen production is shown by the increase in ammonia production dependent on this source. With about 60% of all U. S. production based on steam reforming, the ammonia resulting from this source increased from 1.2 to 3.2-million tons/year in the decade ending in 1960. (In the same period, ammonia based on hydrogen from partial oxidation reached 750,000 tons/year, after its introduction in 1953.) The continuing demand for ammonia-based fertilizers should be a major factor in promoting the growth rate of steam reforming.

► **Steam Reforming**—With steam reforming established as a principal route to hydrogen in this country both now and increasingly so in the future, a look at the process is in order.

In essence, it consists simply of reacting methane (or other paraffins through butane) with steam in the presence of a catalyst, and purifying the resulting gases to remove CO and CO_2.

The most significant development in the art of steam reforming in the past decade has been the gradual increase in the pressure at which the reaction takes place. Formerly operated at atmospheric pressure, units are now being constructed that withstand up to 300 psi.

Despite the fact that the steam-hydrocarbon reaction is favored by low pressure (because two moles of reactants make four moles of product), there are economic advantages to high-pressure operation:

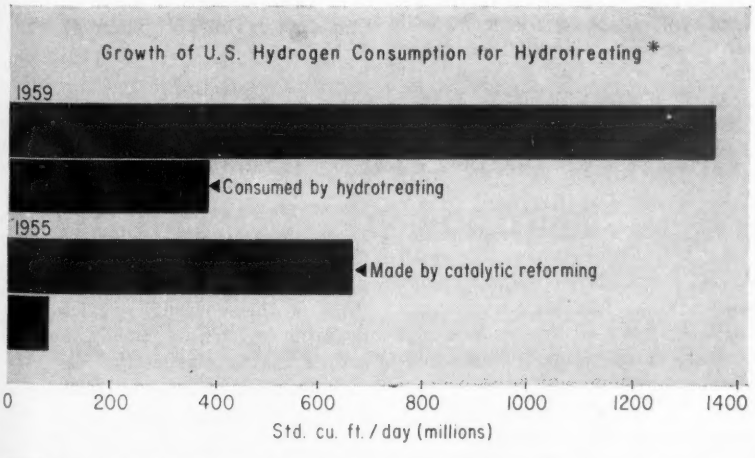
- Gas compression is reduced, particularly since the product hydrogen is usually used at elevated pressures.
- Heat is recovered as high-pressure steam.
- Smaller equipment can be used.

The swing to higher pressure was triggered by the availability of reformer tubes better able to withstand the stresses imposed at 1,500-1,900 F. without excessive tube-wall thickness. Most reformer tubes today are centrifugally cast stainless steel, which have stood up well under the stresses imposed by higher pressures and temperatures.

Some firms look at the pressure race almost as the automakers looked on the horsepower race: We've gone as high as is really necessary for optimum operation, but if a competitor offers a higher pressure unit, we've got to match it.

Others firmly believe that pressure rating will continue to go up as long as suitable materials are available. Both sides can muster reasonable arguments for their case; the coming competition for low-cost hydrogen-producing facilities should help to clear up the picture strictly on a cost basis.

► **System in Operation**—A typical steam reforming furnace receives



* Estimates by M. J. Sterba, G. F. Asselin and R. A. Lengemann in *Refinery Hydrogen Assets—Their Conservation and Use* presented to Western Petroleum Refiners Assn., San Antonio, Tex., April 10-12, 1961.

a preheated mixture of light hydrocarbons (which may have been pretreated to remove sulfur or hydrogenate olefinic contaminants) and steam. The reaction takes place in the presence of a nickel catalyst at temperatures ranging from 1,200 to 1,600 F. The reactions that take place are:

$CH_4 + H_2O \rightarrow CO + 3H_2 -$ heat

$CO + H_2O \rightarrow CO_2 + H_2 +$ heat

The stream emerging from the furnace is a mixture of the products shown above, as well as unconverted methane, steam and any inerts in the feed. CO content is significant since the high temperature of the reaction opposes complete conversion.

To optimize the hydrogen yield, the reforming step is usually followed by a shift conversion in one or two steps, which changes essentially all of the CO to hydrogen and CO_2. This is accomplished by cooling the product gases to a temperature more favorable to the CO conversion (700-800 F.) and adding more steam.

▶ **Purification**—At this point, the gas stream consists almost entirely of hydrogen, CO and CO_2. Various systems are used to eliminate the oxides. The three major ones: ethanolamine, hot carbonate and Giammarco-Vetrocoke processes.

Ethanolamine—CO_2 is absorbed in monoethanolamine (MEA) at moderate temperatures and pressures; the MEA is regenerated by heating to about 230 F. MEA cleanup is desirable where CO_2 level in final gas must be quite low. Disadvantages: regeneration efficiency is not as high as in the carbonate process; MEA makeup is expensive.

Hot Carbonate—For scrubbing operations above 100 psi., potassium carbonate solution can remove CO_2 to a level of 1-3%. If purer gas is necessary, auxiliary cleanup is needed. Regeneration temperatures are lower than for MEA. Chemical Construction Co. has an absorption process in two stages—low and high pressure—that produces a product gas with less than 1% CO_2.

Giammarco-Vetrocoke—An absorbing solution of potassium or sodium carbonate—activated by the salts of multivalent metals such as arsenic, or by organic compounds—can reduce CO_2 content as low as 0.05%. Regeneration is accomplished by stripping out the CO_2 with hot, moist air. The solution becomes oxidized in the regenerator, must periodically be drawn off and treated, to return it to its reduced state.

▶ **Final Cleanup**—Where practically zero contamination from CO_2 and CO is demanded, additional cleanup is necessary. In most instances, this is done by methanation. CO_2 and CO are converted to methane in the presence of nickel catalyst. Process economically converts from 0.1-1.5% CO and CO_2, at pressures from atmospheric to 15,000 psi.

Another route to CO_2 and CO elimination is the molecular sieve. While traditionally associated with small-volume service, sieves have been taking on bigger jobs. Selas Corp. of America uses sieves for handling 2 million cu. ft./day of hydrogen, has designs for systems to handle 4 million or more.—FCP

THERMOELECTRICITY SLATED FOR NEW REMOTE USES

Advances in direct conversion of heat to electricity are making possible compact power packs that can operate unattended in isolated locations.

Three self-contained electricity sources, ranging from small to medium-sized, have all been announced within the past six weeks. Common to all three (each using a different energy source) is the thermoelectric principle, which converts heat directly to electricity.

Texas Instruments has just announced a small (8-w.) thermoelectric unit that is designed for operation in remote, unattended installations. Initial use for the device will be to provide cathodic corrosion protection for pipelines and well casings.

Power for the generator is supplied by burning natural gas at about 3 cu. ft./hr., or LPG. Heat is converted into electricity (2 v.) by lead telluride thermocouples.

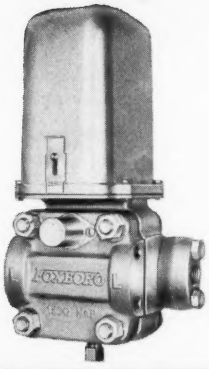
As an outgrowth of the small power packs developed for space applications, The Martin Co. has engineered a 5-w. system powered by heat from radioactive isotopes. First assignment will be to supply power to the radio transmitter of a remote unmanned weather station. Developed for the Atomic Energy Commission, unit is expected to last at least two years and considerably aid weather gathering, since it will permit stations to be placed in regions where men couldn't live for extended periods of time.

Heat source for the generator is radioactive strontium-90. To prevent any possible mishap by accidental discharge of this material (strontium lodges in the bones of animals), the material is converted into strontium titanate, a stable compound that is insoluble in water and could not be ingested. As a further protection, the fuel pellets are surrounded by three layers of Hastelloy-C, and the whole generator is encased in stainless steel.

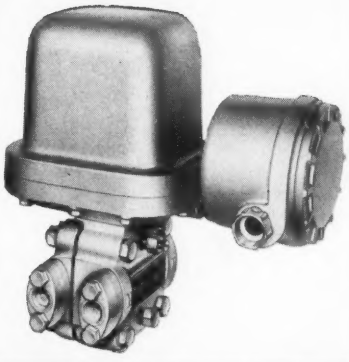
The first weather station package is scheduled for shipment shortly to a remote location north of the Canadian mainland. There it will make year-round observations, transmitting its data about 1,500 miles.

On a larger scale, General Dynamics is developing a portable, 2,000-kw. self-regulating atomic power plant to operate in remote areas. It will employ homogeneous fuel-and-moderator elements of uranium-zirconium hydride. Some form of thermoelectric device will probably be used to convert the reactor's heat to electricity.

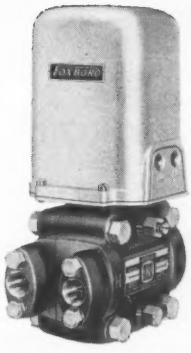
One version of General Dynamics' automated power plant would be applicable to undersea operation as a power source for naval defense systems. Land units could supply power in polar regions.



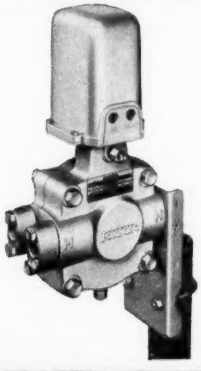
FOR ABSOLUTE PRESSURE



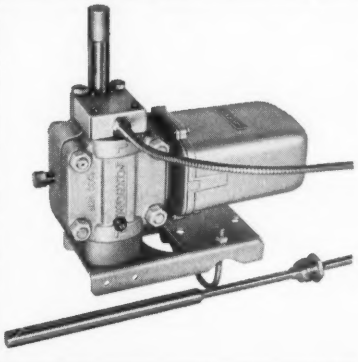
FOR ELECTRONIC TRANSMISSION



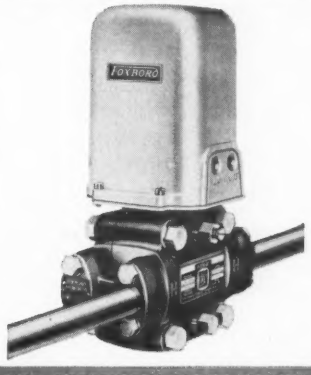
FOR PROCESS FLOWS



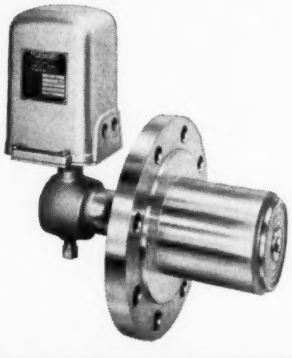
FOR LOW RANGES



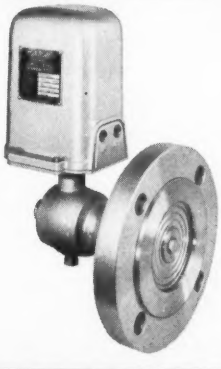
FOR SAMPLE FLUID COMPARISON



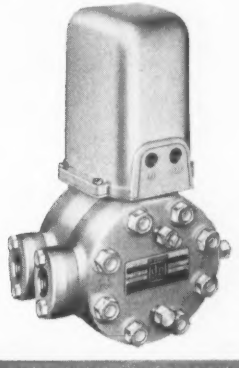
FOR EXTREMELY SMALL FLOWS



FOR FLUSH TANK MOUNTING



FOR DIRECT TANK MOUNTING



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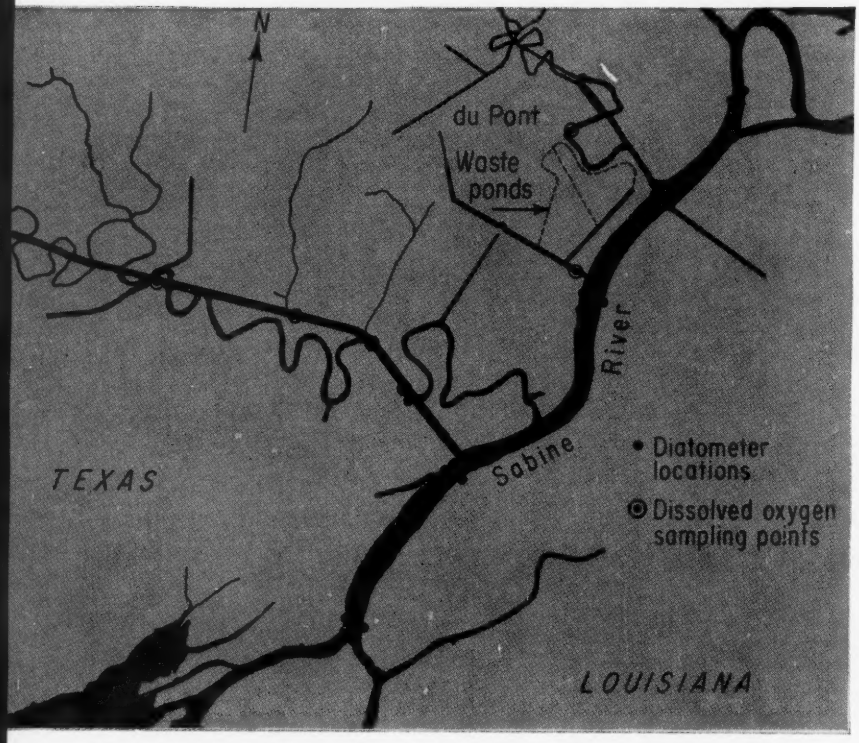
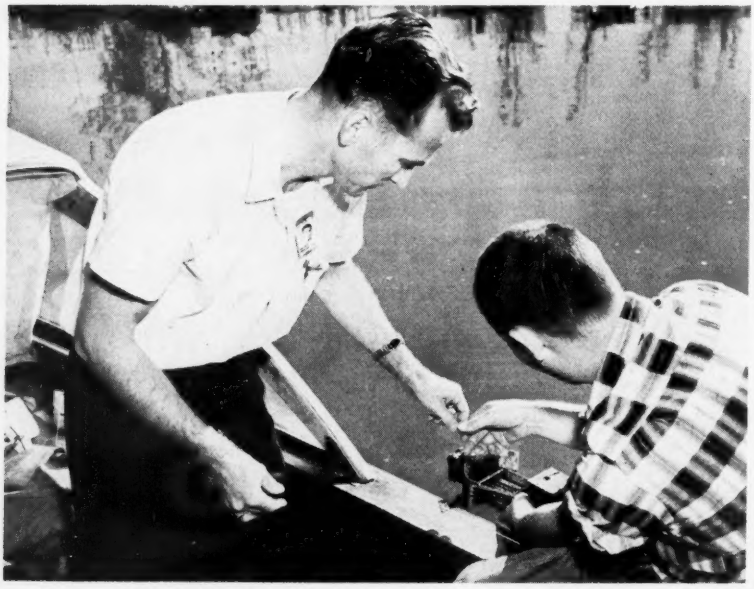
CHEMICAL PLANT USES NATURE'S OWN ANALYZERS





To insure adequate time for trapping representative samples of marine life, each diatometer holds six slides which are changed on a twice-a-week basis.

Giant chemical complex relies on microscopic one-cell diatoms in river to indicate any breakdown in water pollution control measures.

To check the effectiveness of water pollution control at its Sabine River Works, Orange, Tex., E. I. du Pont de Nemours relies on Mother Nature's own telltale—the conditions of one-cell diatoms in the river.

As a basic form of marine life near the bottom of the food chain, these microscopic aquatic plants are sensitive to all changes in water conditions. And they have proved to be the most reliable indication to date of the health and purity of a stream, as well as the most practical means of preserving evidence about these conditions for later reference.

▶ **Fishing for Diatoms**—In order to keep tabs on how the diatoms are prospering, Du Pont maintains floating diatometers at ten different river and bayou stations above and below the plant (see map). Twice a week, plant personnel change the diatometer slides, shipping the loaded ones to the Academy of Natural Sciences in Philadelphia for evaluation. At the same time, water samples are taken for analysis of dissolved oxygen in the plant laboratory.

Results from these samplings give Du Pont engineers clear indication of any breakdown in the control procedures on aqueous effluents and cooling water leaving the plant. Together with techniques employed on other wastes, control procedures for waste waters have brought the Sabine River Works close to complete elimination of pollutants from all effluents leaving the plant.

Achievement of this status is due to recent success with bio-treatment of dilute water-borne acidic and organic wastes—in operation

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55 Gal. Drums 50 drums	5,000	Amorphous Powder	11.75
Tank Car 8,000 gals.	11,200	SWS	7.50
Tank Wagon 3,000 gals.	4,200	SWS	11.00
Truck Load 50 drums	3,600	SWS	11.50
55 Gal. Drum 1 drum	72	SWS	13.00
55 Gal. Drums 10 drums	720	SWS	12.50

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on a trial basis since the summer of 1960.

▶ **Hurricane Helped** — Strangely enough, successful development of bio-treatment got an unexpected helping hand from 1957's destructive hurricane Audrey.

Before Audrey struck, the Sabine River Works had used two large ponds for retention of concentrated waste water, especially during spring and summer months when there was insufficient river flow to properly dilute the waste. No biological activity was evident in the ponds although plant engineers were experimenting with consumption of the waste by aerobic bacteria.

After Audrey departed, plant engineers noted minnows and other indications of life in the ponds, apparently the result of dilusion by the flood waters. There was evidence furthermore that aerobic oxidation of impounded wastes had started.

Subsequently, by diluting fresh acid waste with river water at the inlet of the pond, the engineers were able to stabilize biological activity at a satisfactory level. In the present 100-acre ponds filled to 3-ft. depth, plant effluent undergoes biological treatment for approximately one month before discharging into an outfall.

▶ **Other Tributaries**—The same outfall also handles quench water and plant cooling water discharging to the river. Before flowing into the outfall, quench water passes through an API separator for removal of oil.

Coolant tributaries leading into the common outfall have pH monitors. On the outfall, in addition to another pH monitor, there is also a device that automatically samples the composite flow.

▶ **Other Disposal Methods**—Oil removed from the quench water in the API separator is trucked, along with some other combustible liquids, to an open pit for burning by means of special equipment that assures essentially complete, smokeless combustion. Other harder-to-burn waste liquids are fed into the high-temperature combustion zone of a furnace.

Smokeless combustion of wastes must share credit with catalytic reduction for stopping air pollution.

For more than six years, Du Pont's Sabine engineers worked to develop catalytic reduction equipment that now eliminates discharge of brown nitrogen oxide fumes to the atmosphere from the nitric acid plant. The $250,000 installation even includes special burners to decompose gases venting from tanks.

PAPER INDUSTRY SEES BRIGHT FUTURE DESPITE CURRENT LULL

Though troubled by the present break in their long-term growth trend, U.S. paper manufacturers are still looking ahead to excellent prospects for expansion, both at home and abroad (*Chem Eng.* Dec. 12, 1960, p. 62).

By 1965, the industry will turn out an additional 9.5 million tons of products, raising production to 44 million tons per year, according to "The American Economy," a McGraw-Hill Dept. of Economics report. Sales should reach almost $16 billion, although profits will not regain the heights of early postwar years.

Long-range forecasts show that by 1975 domestic production will rise to 65.6 million tons and worldwide use of paper will be almost twice as great as today. Abroad, largest increases may come in countries such as India or Russia, whose combined consumption is less than 10% of the U.S. total.

▶ **Need to Act Now**—To take advantage of these rosy predictions, the nation's papermakers will have to plan now in order to cope with the 4-5-yr. lead time required to build and install new equipment. But there may be some reluctance to step up expenditures in the face of the present 85% operating rate and shrinking profits. Both this year and next, operating rate will average out at the 85% level—the longest period of low-capacity operation since 1939.

At the moment, these conditions seem to be swinging capital expenditures toward modernization of existing facilities, with 55% committed to this end in 1960, 68% in 1961 and 74% in 1962-64. But the market projections to 1975 indicate that modernization will have to tail off in favor of further expansion within the relatively near future.

▶ **Need More Research**—Potential markets may fail to materialize to the extent needed to absorb expanded output unless additional sums are committed to research.

The industry's profit margins were eroding even before its peak year for new capacity and total profits in 1957. In its determination to expand, paper had paid scant attention to developing new products and processes—basic ingredients for boosting sales under intense competition.

Lack of basic research, due to money shortages of the Thirties and overemphasis on expansion after 1939, was obscured by attention to:

- Modernized forestry.
- Updated management.
- Purchase of forest lands.
- Acquisition of wholesale outlets.

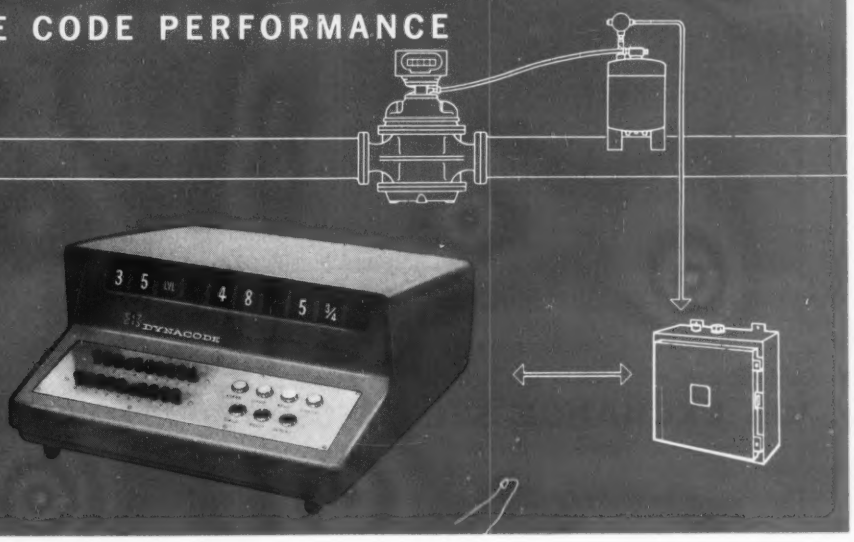
Although R&D expenditures rose from $27 million in 1953 to $75 million this year, the paper industry still performs less research than any other major industry except textiles. Even by 1965, research expenditures will probably be less than $95 million, much of which will be for new processes rather than new products.

However, research looked better related to 1960 sales. Papermakers spent 0.61% of their sales dollar for R&D, topping steel, food and textiles.

The long-range future of paper research looks good, too. By 1970 the outlay may jump to $170 million. So there's hope that this increasing effort will provide the push needed to open up the potential market.

DYNEL DYNACODE TELEMETERING SYSTEM

A NEW HIGH-SPEED REMOTE MONITORING SYSTEM BASED ON 6 YEARS OF FIELD PROVEN VAREC PULSE CODE PERFORMANCE



The 3-second DYNACODE telemetering cycle is activated by either push-button (shown here) or dial to contact data point. Response goes from data point, through a transmitter to a remote multi-point selector which then sends the data to the receiver where it is decoded and digitally displayed.

Dynel engineers—utilizing the performance proved concepts of Varec's famous Pulse Code system—have developed the significantly advanced DYNACODE telemetering system for remote readings of liquid level, temperature and P.D.M.

This single-channel, "error-proof" system combines the proven reliability of the basic Varec system with a digital readout time of 3 seconds per point... readout accuracy of 1/16 inch... readout capacity of an unlimited number of points... and readout versatility that permits the system to be tied into a general purpose computer for inventory, billing, and similar functions.

Solid state components are used at key points in the receiver design for longer, maintenance-free life. And DYNACODE, like Varec's Pulse Code, has an instantaneous alarm system without scanning delays.

The high-speed DYNACODE System offers these advantages:

Reliability: Design based on 6 years of performance in scores of pipeline and refinery applications.

Data Display: Illuminated, in-line digital display includes point and function identification, digital data to 6 significant figures and liquid level to 1/16" increments.

Fast Response: data from any given point is gathered and digitally displayed in just 3 seconds.

Flexibility: Designed on building block principle that permits a great variety of system arrangements... DYNACODE is compatible with all standard systems of measurement.

Readout Variety: digital output provides a variety of readouts, including visual display, paper tape, typewriter, etc. Output is compatible for use with general purpose computers.

For complete information, see DYNACODE at the ISA Show, Los Angeles Sports Arena – Booth #170. Or write for Bulletin 301, Dept. CHE-1600-1

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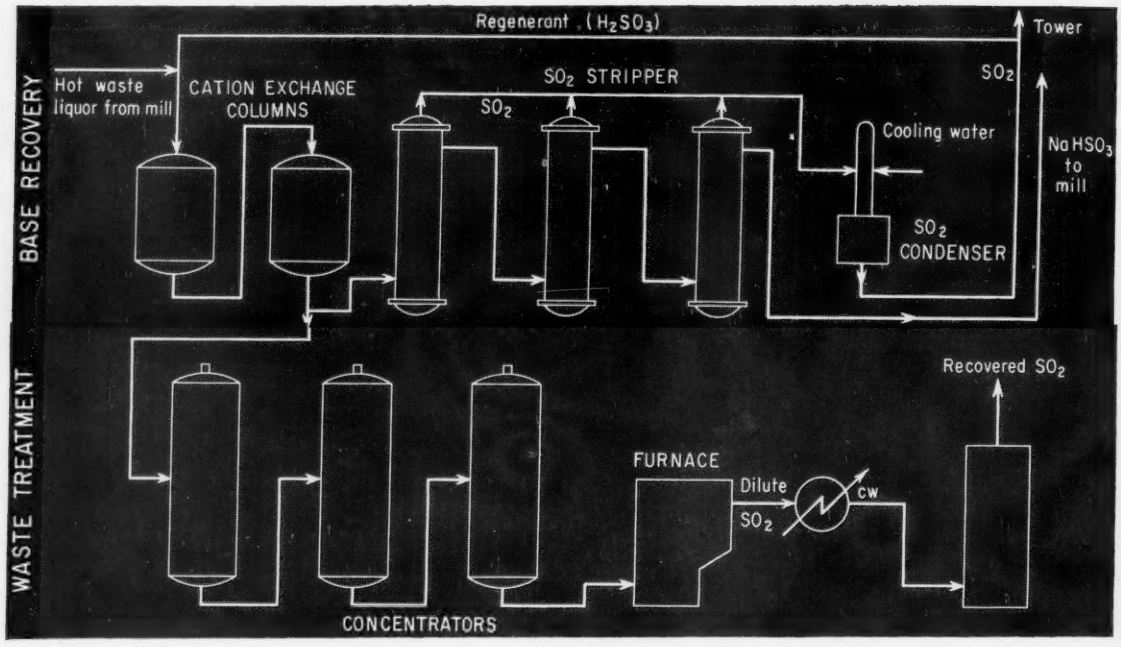


Abiperm process bypasses calcium removal step, recovers base ions in exchanger, returns them to mill as $NaHSO_3$.

ION EXCHANGE SEEN AIDING SODIUM SULFITE PULPING

Two new processes that recover sodium and ammonia from waste sulfite liquor could make soluble-base sulfites competitive with calcium compounds. And they also reduce pollution problems.

The outlook for sodium and ammonium sulfite pulping has brightened considerably with the recent disclosure of two new ion exchange processes for the recovery and re-use of these chemicals.

Described in detail at the mid-June meeting of the Canadian Pulp & Paper Assn., at Saranac Lake, N. Y., these techniques are seen aiding paper mills in reducing stream pollution and in the recovery of valuable byproducts.

One of the processes, (Abiperm), developed by Abitibi Power & Paper Co. and the Permutit division of Pfaudler Permutit, has been the subject of extensive tests at Abitibi's Sault Ste. Marie mill. The company has drawn up a proposed flowsheet (above) for integrating the process into an existing mill.

In a pilot-plant, scaled to handle liquor from 1 ton of pulp/day, the Abiperm process has converted over 80% of the sodium contained in sodium-base sulfite spent liquor to usable product at a concentration of 1% combined SO_2. Ammonium- and magnesium-base sulfite liquors were evaluated on a semipilot scale.

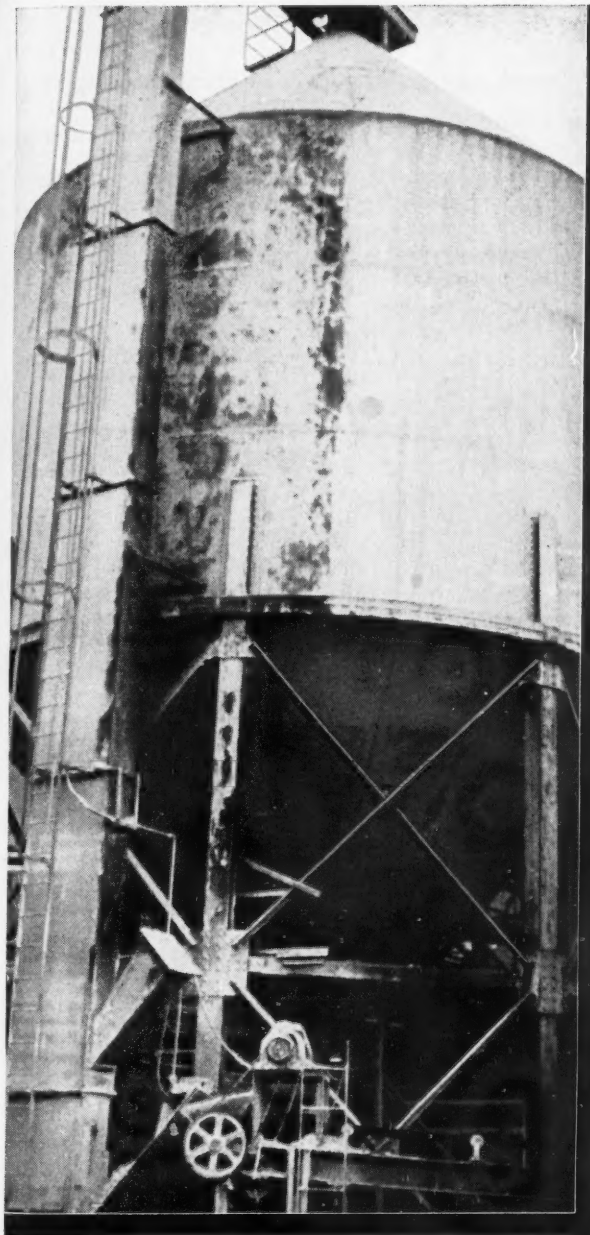
The second process was developed by the Ontario Research Foundation, Toronto, for J. F. Pritchard & Co., Kansas City, Mo. Rights to the Canadian patent 618,158 have been assigned to Pritchard.

An important feature of this process is a "conditioning" step whereby troublesome Ca, Mg and Fe ions are removed before an effort is made to recover the sodium or ammonium ions. The Abiperm process bypasses this step because the capacity of the sulfonic type resin, Permutit Q, employed in its exchanger is not greatly reduced by presence of Ca ions.

▶ **Abiperm Process**—Abitibi's pilot plant obtains spent sodium-base sulfite liquor directly from the blowpit of the company's 80-100 ton/day Sault mill. After passing through a 60-mesh screen, the liquor may be steam-stripped to remove volatile acids, decalcified to remove interfering cations, or may go directly to the exchanger.

After giving up its sodium to the resin bed, the effluent is discharged to the sewer. In a plant-size installation, however, it would be diverted to more profitable uses. As the effluent is largely in the form of ash-free lignosulfonic acid and contains all of the organic matter salvaged from the blowpit, it has a very high calorific value, could be used therefore as fuel.

Release of the base from the resin is by regeneration with sulfurous acid to form bisulfite. Its passage through the exchanger restores the resin to its hydrogen form, ready for the next loading.



New Defense Against Corrosion

(and Mounting Maintenance Costs!)

Du Pont CORLAR(T.M.) Epoxy Enamels Afford Excellent Resistance to Chemical Spills and Fumes, Moisture and Heat up to 300° F.

Now a new kind of protective finish can help you solve *difficult* corrosion problems—and hold down skyrocketing maintenance costs. CORLAR Epoxy Chemical-Resistant Enamels combine excellent resistance to atmospheres containing mineral acids, alkalies, strong aromatic and aliphatic solvents with remarkable adhesion and heat resistance. They're also easy to handle, weather well, remain flexible at low temperatures.

Key to the success of these new coatings is a polyamide activator that binds molecules into a hard, firm film that literally *locks out* corrosion. Amide activator also makes CORLAR finishes safer to use and more stable; gives them 10-15 times longer pot life than amine types. Moreover, the epoxy resin's outstanding adhesion helps coatings stand off deterioration for years.

Two-package CORLAR Epoxy Enamels can be used indoors or out with equal success, apply easily with brush, roller or spray. Five standard colors are available, as well as black and white.

For prolonged exposure to severe mineral and organic acids, use Du Pont IMLAR(T.M.) vinyl coatings. See your local Du Pont sales representative for expert technical help. For more detailed information on these new finishes, clip and mail the coupon *today*.

Tested and proven on the job. After three years of continual exposure to corrosive fumes, moisture and salt spray, CORLAR coating on right side of lime tank is still in good condition. Commonly used phenolic resin coating on left side, however, has deteriorated completely—permitting rust and corrosion to take over.

CORLAR(T.M.)

Epoxy Chemical-Resistant Enamels

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City_____ Zone_____ State_____

According to Abitibi, the base recovery process should be compatible with soluble base cooking in acid sulfite and bisulfite systems. Because of limitations imposed by ion exchange product concentration, relative to cooking liquor demands, it has less utility with neutral sulfite semichemical installations. In other high-yield sulfite systems, it appears to be the only feasible method for base recovery.

Based on pilot-plant data, Abitibi feels that the process will be profitable even without recovery of lignosulfonic acid values from the effluent. Estimated payout times for mills with capacities of 80-225 tons daily range from 6.8 to 2.6 yr.; and savings of $1.17-3.90/ton of pulp appear possible.

▶ **Foundation's Approach**—In the Ontario Research process, calcium and other multivalent ions are first removed from the waste liquor in the "conditioning" step, which is comprised of three ion exchange columns. The liquor is then passed through a second exchanger (four columns) where the hydrogen ions on the resins are replaced by ammonium and/or sodium ions.

The first set of columns is regenerated with strong ammonium bisulfite solution, with replacement of the calcium ions by ammonium ions. Effluent from this regeneration is steam-stripped to recover SO_2 and precipitate calcium, mixed with a predetermined quantity of raw cooking liquor, then fortified with NH_3 and SO_2 for re-use in regeneration.

Regeneration of the second set of columns is by backwashing with sulfurous acid solution to form unfortified ammonium bisulfite pulping liquor, which is returned to the mill.

For continuous operation, only two of the columns in each set are used at one time. In the conditioning step, the remaining one is being regenerated, while in the pulping liquor recovery step, two are being regenerated regularly.

According to Ontario Research, none of the ammonium cations used to regenerate the resins in the conditioning step are lost—they eventually wind up in the product recovery system.—AVG

German Chemical Industry: Big Market for Computers

Faced with a desperate manpower shortage, a rapidly increasing complexity in its business operations, and sharpening world-wide competition, the West German chemical industry is beginning to turn to the most advanced techniques of automation for help.

Latest case in point: Chemische Werke Huels AG—fourth largest German chemical maker—has just announced installation of a new computer center at Marl. The system will serve principally to process the full range of business data for the firm. In addition, it will be used for correlating and calculating analytic, quality- and production-control data for laboratory and plant. And a great bulk of engineering calculations for design of new facilities will be run through it.

A large number of American chemical firms are presently operating equipment of the same capacity and complexity as the new Huels installation. But, Heuls' new computer center is easily the most advanced setup in the chemical industry outside the U. S.

The units involved, rented from IBM Deutschland GmbH., German manufacturing subsidiary of International Business Machines, include a high-speed, four-channel IBM 7070 computer with eight IBM 729 magnetic tape units and two IBM 1401 data processing units.

West Germany's chemical industry has, of course, used electronic data processing devices right along. But, considering the highly developed state of their technology, chemical makers have been relatively slow to apply the advances made in the computer field. For example, they're doing very little about the possibilities of computer-controlled processes. Only one, Badische Anilin- und Soda-Fabrik, is known to have ventured into this area.

Huels itself relegates such schemes to some vague distant future, despite the fact that some of the equipment it now has installed would be adaptable to simple process control applications. Other major German chemical makers also remain quite cautious and hesitant when discussing prospects of computer-controlled plants.

Nevertheless, German computer people are highly optimistic that Huels' plunge into a relatively elaborate computer setup may signal the German chemical makers' awakening.

Process-Control Men Hear Experts Stress Economics

At the second Joint Automatic Control Conference (JACC), in Boulder, Colo., June 28-30, over 600 engineers and scientists—many from the process industries—heard:

• Commissioner Ewan Clague, of the Bureau of Labor Statistics, say that those marginal firms that can't or don't automate tend to fail, throw workers out of jobs. He averred, on the other hand, that engineers could help the government's planners by warning of imminent changes in technology that might cause local labor dislocations.

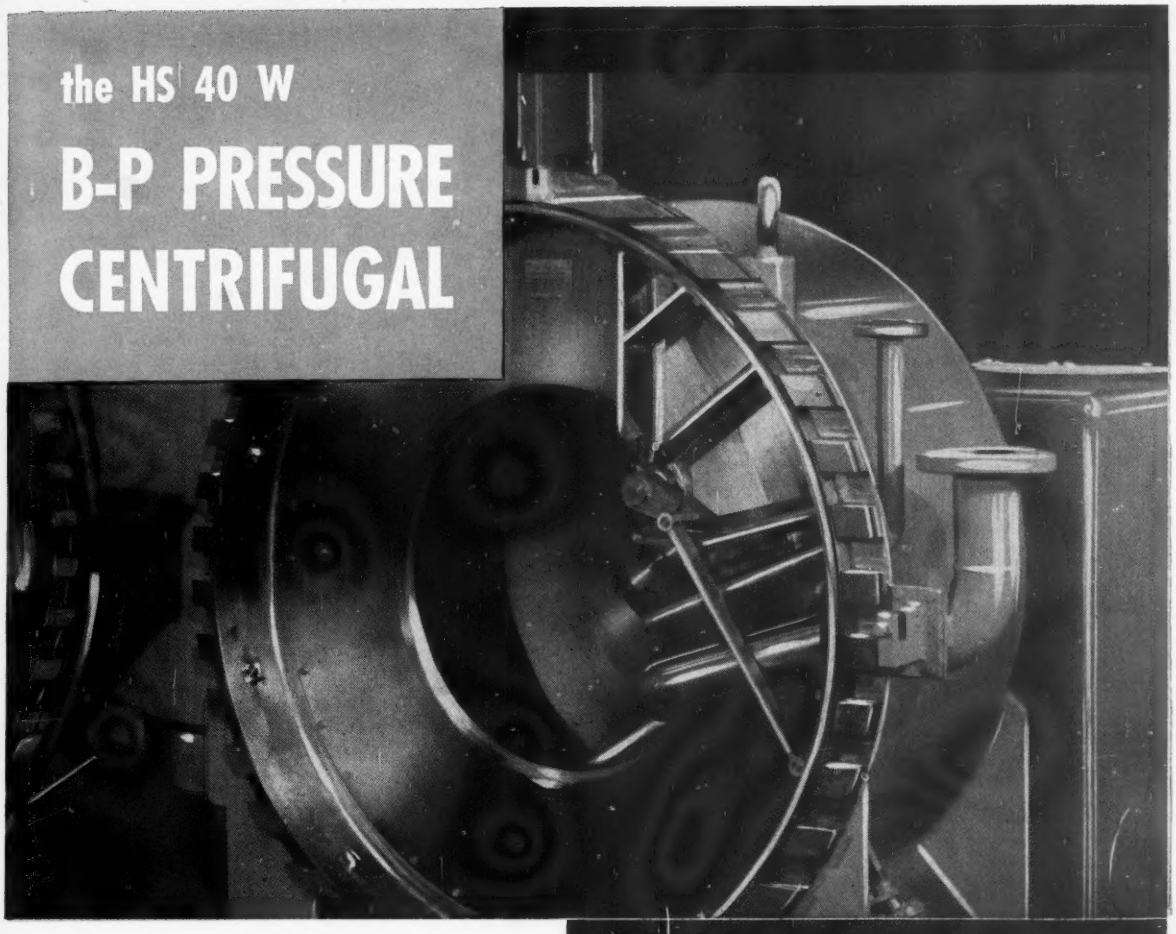
• Harold Chestnut, of General Electric, outline three cost models for analyzing control systems. Each model, based on the standard economic balance, considers costs in a different set of time conditions. Chestnut showed where various chemical processes fit in these three models.

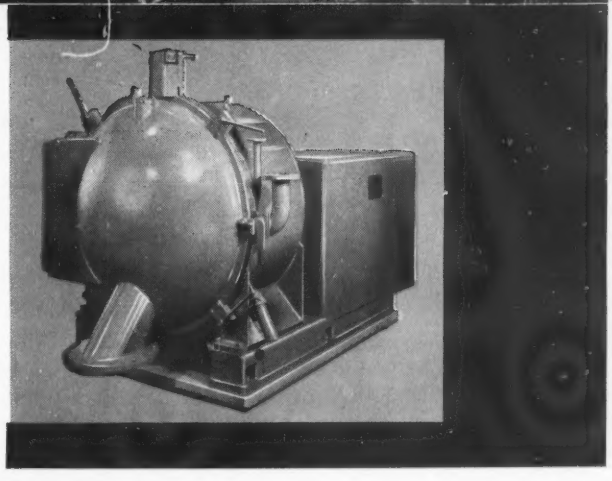
• A Texas Butadiene & Chemical Corp. engineer show, mostly from economic figures estimated by *Chemical Engineering*, how computer-control incentives shape up, now that some firms have on-line experience.

Main topic outside meeting rooms: Whether U. S. should step up its automation pace as Russia appears to be doing? Good sign for five-society-sponsored JACC: AIChE steering committee for 1963 meeting held its first caucus at the Boulder conference.

Other societies sponsoring the JACC are: Instrument Society of America, American Institute of Electrical Engineers, American Society of Mechanical Engineers and Institute of Radio Engineers.

the HS 40 W
B-P PRESSURE CENTRIFUGAL





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As in all Baker Perkins Universal Centrifugals, the interior of the new model is completely and readily accessible. For complete specifications of the high capacity HS 40 W Universal Pressure Centrifugal, see your B-P sales representative or write to:

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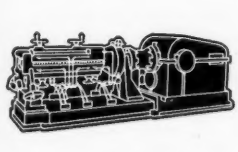
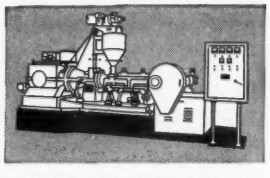
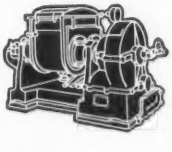


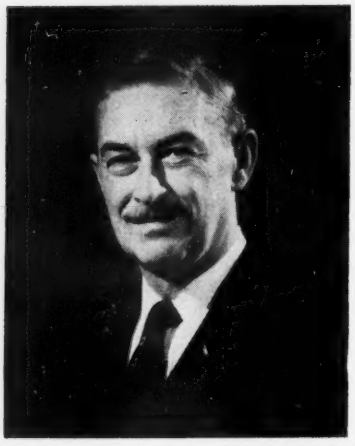




394R

CONTINUOUS MIXERS • PLASTICS MACHINERY • UNIVERSAL MIXERS

SAGINAW, MICHIGAN



Lionel Corp.'s John B. Medaris

Medaris to Discuss Fate Of Small-Company Research

How can small companies, with limited research resources hope to compete with the giant corporations in the years ahead?

This is one of the questions that General John B. Medaris, president of Lionel Corp., will discuss in a speech to be delivered on Oct. 11, as part of the conference on "New Trends in Chemistry." Other topics to be covered in his examination of the present state of research development are the relation of R&D to this country's defense effort and the new look of tomorrow's business managers.

General Medaris' banquet address will be a feature of the conference, to be sponored by Armour Research Foundation and *Chemical Engineering* in Chicago, Oct. 11-12. Details about preregistration and hotel reservations will appear on these pages in an upcoming issue.

Before joining Lionel in 1960, Medaris was in charge of the Army's Ordnance Missile Command, holding the rank of major general.

Among his many duties were administration of an annual budget of $2 billion, 90% of which was spent with private industry; command of the Redstone Arsenal and the White Sands Missile Range; and responsibility for the launching of Explorer I, this country's first earth satellite.

Upon retiring from the Army on January 31, 1960, General Medaris wrote the controversial "Countdown for Decision," a critical appraisal of some of this country's defense and space policies.

Since joining Lionel, he has expanded the scope of the well-known toy and train manufacturing firm into electronics, nucleonics and research and development in missiles and allied fields.

General Medaris had a varied career in business before World War II. He resigned from the Army in October, 1927, after six years of service, to enter business in the Republic of Colombia. He returned to the U. S. a year later and engaged in management and merchandising activities in the East and Midwest for the next ten years.

Medaris returned to the Army in July, 1939, and became the Executive Officer of the Cincinnati Ordnance District. He was attached to the Office of the Undersecretary of War before beginning an overseas tour of duty in the spring of 1942.

He became the first commanding general of the Army's Ballistic Missile Agency in 1955.

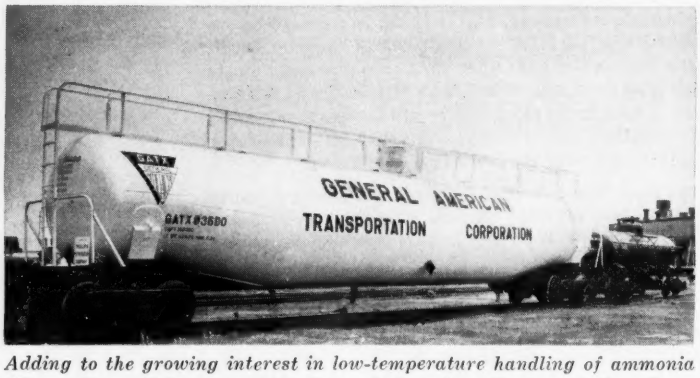
Seat Belts Give Lift To Nylon-Fiber Market

Nylon-fiber marketers are being pleasantly surprised by an old, but traditionally small customer—the safety seat-belt industry. This market has suddenly come alive, sparked by the auto markers' decision to put standard fittings on 1962 cars (making it easier to install belts), plus a $10-million advertising campaign.

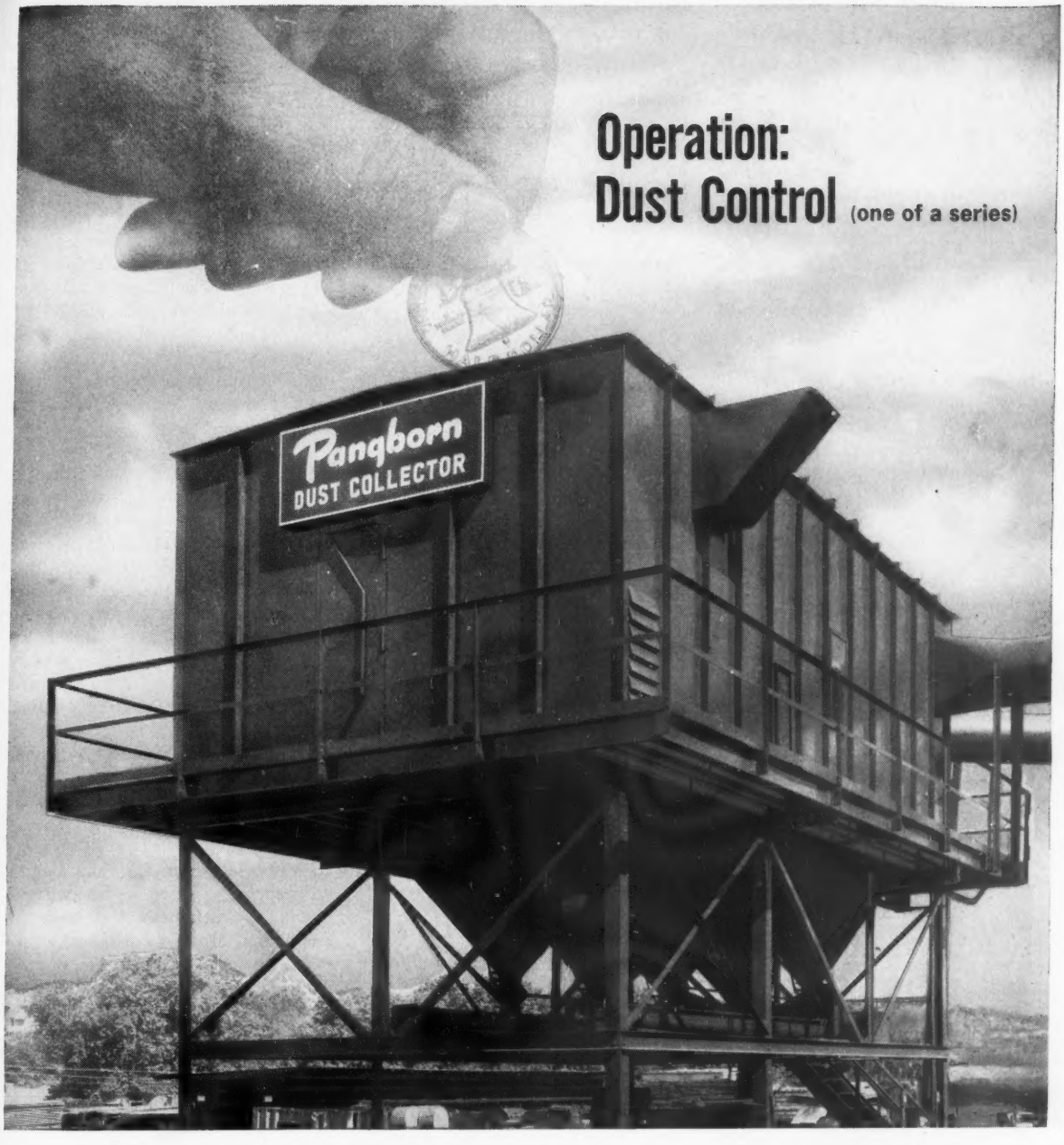
The advertising effort will be part of the public service program of The Advertising Council. It will dramatize, via all media, the safety benefits that would result if America's 60 million automobiles were equipped with seat belts.

The abrupt change in the sales climate for seat belts has been a boon for nylon. Allied Chemical reports that it sold 800% more Caprolan (nylon-6 fiber) to seat-belt makers in the first five months of 1961 than during the same period last year. Though there isn't much nylon in each belt (1/3 lb.), even a small increase in the percentage of U. S. cars so equipped (now 3-5%) would be a welcome market stimulus.

Low-temperature ammonia hits the rails



*Adding to the growing interest in low-temperature handling of ammonia (*Chem. Eng., *Feb. 20, p. 88), General American Transportation Corp. has developed a unique tank car to handle liquefied anhydrous ammonia and LPG. Fifty of the new cars, each with a capacity of 30,300 gal., have been purchased by Phillips Petroleum. Car is only 66 ft. long, 19 ft. shorter than other large-volume cars, which gives it greater maneuverability in crowded loading areas. One unusual feature is that the tank acts as the structural connection between the two truck mountings.*



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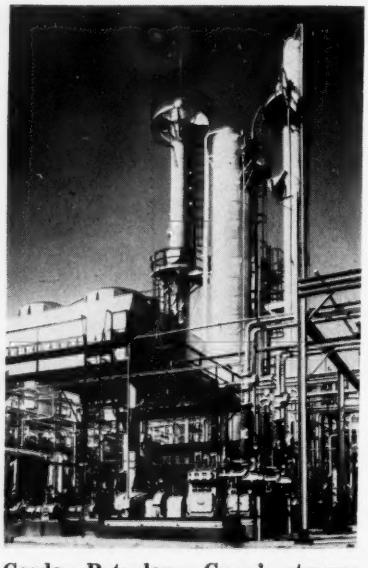
Plants

AviSun Corp. has begun preliminary equipment testing at its 100-million-lb./yr. polypropylene plant in New Castle, Del. Created in 1959 as an equally owned affiliate of American Viscose Corp. and Sun Oil Co., AviSun already makes 25 million lb./yr. of resin at Port Reading, N. J., will claim title as the world's largest polypropylene producer when its New Castle facility is formally dedicated in September. The multimillion-dollar installation was engineered by AviSun and the Bechtel Corp., based on an AviSun process. Propylene feed comes from Sun Oil's Marcus Hook refinery, about 20 miles up the Delaware River from New Castle.

Du Pont has placed its multimillion-dollar caprolactam plant on stream at Beaumont, Tex. Capacity of the nylon-6 intermediate is rated at 50 million lb./yr.



Cosden Petroleum Corp.'s styrene capacity has been tripled by the installation of two new units at Big Spring, Tex. Pictured above is the world's first commercial UOP Alkar unit, erected for Cosden by Badger Mfg. Corp., to provide the additional ethyl benzene feed for the two styrene facilities. Companion piece to Cosden's styrene-from-gasoline unit, on stream since Feb. 1957, the Alkar installation catalytically alkylates benzene with ethylene, is the key to Cosden's new styrene capacity of 60 million lb./yr.

Hydrocarbon Research, Inc., will build a $6.5-million air-separation unit at Pasadena, Tex., to supply Tenneco Chemical Co.'s new petrochemical complex with 730 tons/day of oxygen and nitrogen.

Rohm & Haas Co. plans to have an adipic acid unit on stream by late next summer at Louisville, Ky., site of the former Government-surplus butadiene plant that the firm bought last year. No capacity figures have been disclosed for the multimillion-dollar facility, but a contract has been signed with Scientific Design Co. to design and construct the plant. Process is licensed from SD, makes the acid from cyclohexane.

Kerr-McGee Oil Industries, Inc., has brought a vanadium extraction circuit on stream at its Shiprock, N. M., uranium mill. The firm also plans to install the process at its Lakeview, Ore., mill, which was acquired recently by the purchase of Lakeview Mining Co. The Lakeview plant will probably be modified to produce vanadium for six months of the year, uranium oxide (yellow cake) for the other half.

Allied Chemical Corp.'s National Aniline Div. has brought its 20-million-lb./yr. Actol polyether plant on stream at Baton Rouge. The firm thus becomes the first domestic supplier of all major components for the burgeoning urethane industry (whose 1965 market has been pegged at $300 million). Almost simultaneously, the division announced plans to build a 15-million-lb./yr. isocyanate plant in southern California.

Southern Nitrogen Co. has announced a $5-million expansion program, principally for its Savannah, Ga., nitrogenous products complex. Anhydrous ammonia capacity there will be boosted by 50%, to 150,000 tons/yr. The project complements the firm's current $1.3-million expansion of nitric acid and urea capacities (to 33,000 and 7,000 tons/yr., respectively) at the site.

Spencer Chemical Co. plans a 50,000-ton/yr. fertilizer unit at its Jayhawk Works near Pittsburg, Kan. The high-analysis plant food will contain 30% nitrogen, 10% phosphorus. Construction is scheduled for completion in time for production during the 1962 fertilizer season.

State of Connecticut enters the nuclear energy field through authorization by its General Assembly for a state-subsidized nuclear research center, either at the University of Connecticut in Storrs or at Yale University, New Haven. Industry is being asked to put up "at least $1 million"—but preferably $1.5 million or more—toward construction of the center, chief aim of which would be the exploration of nuclear energy for industrial uses. The state will float a $500,000 bond issue to cover initial construction costs.

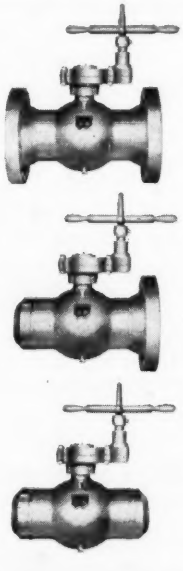
Hercules Powder Co. has begun constructing two agricultural chemical units near the town of Louisiana, Mo. One will make 50,000 tons/yr. of ammonium nitrate solution; the other, an undisclosed tonnage of ammoniated ammonium nitrate. Both are due on stream in about a year.

FMC Corp.'s Becco Chemical Div. is constructing a multimillion-dollar hydrogen peroxide plant at the former South Charleston, W. Va., Naval Ordnance Works. Becco will use a "new and highly developed organic" process, which apparently differs radically from the typical anthraquinone route.

The Mead Corp. has officially opened the radioactive tracer laboratory at its $4.5-million paper/pollution research facilities in Chillicothe, Ohio. Among the new hardware are two surprises: a

CPI News Briefs continue on page 162

"WE STANDARDIZED ON CAMERON BALL VALVES"



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FIRE EXTINGUISHER OUTSTRIPS ITSELF—AND ITS THEORY

Traditional theory of how a flame is killed won't fit the action of $CBrF_3$—seven times as effective as CO_2. Result: new theory.

A new theory of fire extinguishing has had to be developed, due to the performance of a fluorocarbon that Du Pont has trademarked Freon FE 1301.

Chemically, the agent is liquefied bromotrifluoromethane ($CBrF_3$). Based on data taken from tests of the U. S. Army Corps of Engineers and by Underwriters' Laboratories, $CBrF_3$ is 6-12 times as effective as CCl_4 (on a weight-of-agent basis), 3½-7 times as effective as CO_2, almost twice as effective as the dry-chemical bicarbonate-of-soda type.

►**Up Till Now**—Historically, the effectiveness of fire extinguishing agents has been attributed to one of three types of action: cooling, oxygen smothering, or mechanical separation of the fuel from the oxidizer. Water cools Class A fires; carbon dioxide illustrates the smothered-oxygen principle (though it incidentally cools, too); while mechanically generated protein foam kills Class B fires by isolating the fuel from the oxidation vapors (again, the foam's water moisture has some cooling effect).

But $CBrF_3$ fits none of the three classes. Some cooling effect is to be expected, since the fluorocarbon's boiling point is −72 F.; but the amount of heat it soaks up in vaporizing and warming to ambient temperature is negligible compared with the heat given off by a blaze.

Then too, since $CBrF_3$ is heavier than air, FE 1301 might be expected either to smother the fuel or isolate the oxidizer by a blanket of vapor. But the ventilation and air disturbance in most fire situations lends little validity to this view.

Relative fire-killing effectiveness

FE 1301, bromotrifluoromethane	100
Dibromodifluoromethane	67
Dry chemical (e.g., $NaHCO_3$)	66
Dibromotetrafluoroethane	57
Bromochlorodifluoromethane	46
Bromochloromethane	45
Carbon tetrachloride	34
Carbon dioxide	33

Source: Joint research of Du Pont and Ansul Chemical Co.

►**New Theory**—Best explanation for the way FE 1301 works is a chemical reaction between the fluorocarbon and transient combustion products that cause rapid and violent flame propagation. The hypothesis is that such a reaction with a halogen compound would terminate the chain reaction of combustion, hence slicing off the flame.

This theory gains credibility by the effectiveness of the vaporizing liquids in controlling fires at aircraft power plants, where air movements are more often stiff gusts than gently wafting currents or disturbances.

►**The Product Itself**—FE 1301 is a colorless, compressed and liquefied gas with a low viscosity (about 0.2 cp. at 70 F.) and high density (13.1 lb./gal.). Its heat of vaporization is 47.7 Btu./lb.

Nontoxic, the agent is inert toward most metals, all elastomers except silicone rubber, all plastics except ethyl cellulose and possibly cellulose acetate/butyrate (both of which swell slightly on contact). It squelches both Class B (flammable liquid) and Class C (electrical) fires, leaving no residue.

A conventional fire extinguisher containing 2¾ lb. of FE 1301 has received UL 4-B:C rating, might qualify for 6-B:C (to put out a standard 15-sq. ft. gasoline fire). Extinguishers can be built with compressed nitrogen as superpressurizer of the FE 1301, to meet U. S. specifications of operability down to − 65 F.

►**Prospects**—Still not fully commercial, FE 1301-filled extinguishers are currently being used in large volumes only by the U. S. Army Corps of Engineers and several commercial airlines. But by October, The Fire Guard Corp. plans to market an extinguisher that contains 2½ lb. of the fluorocarbon, and qualifies for Class 4-B:C rating. And Du Pont says several other large manufacturers are looking at the agent as an addition to their fire-fighting lines as well.—**E. I. du Pont de Nemours & Co., Wilmington, Del.** 78A

Board

Forming board is stretchy, can be deep-drawn, has no asphalt.

Dubbed Form-L-Board 200, The Mead Corp.'s new kraft-type paper "forming board" is aimed squarely at capturing the well-established markets of asphaltic and panel

Three great names in couplings

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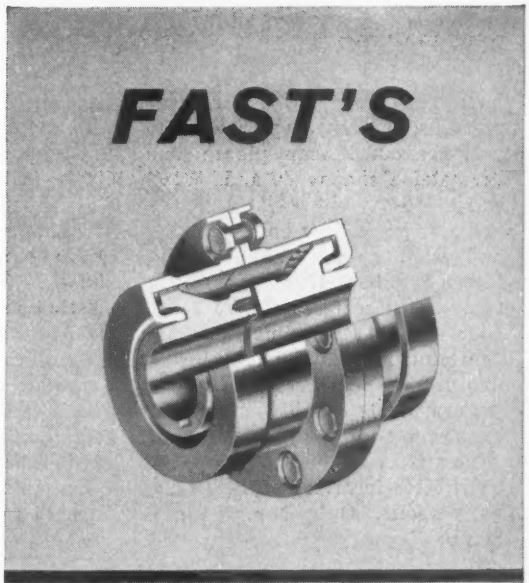
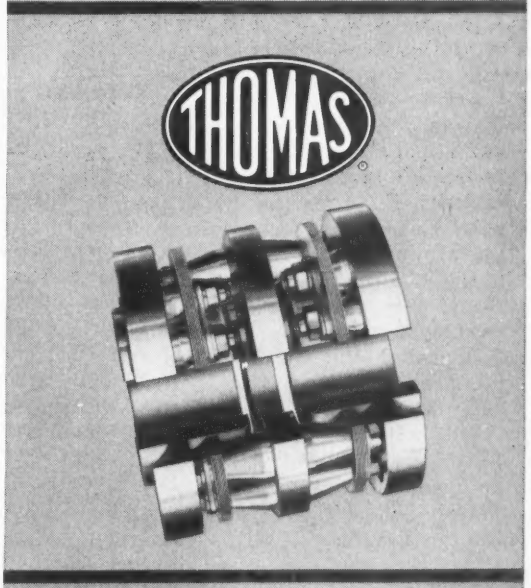




boarding. It's stretchy, more tear-resistant, can be deep-drawn into complex curvilinear planes and geometric shapes — and won't warp.

Major market for both asphaltic and panel boarding is automotive interiors (about 10,000 tons/yr. of visors, side seat shields, roof and door panels, etc.). But these are becoming more and more curved, and neither board can fill the bill.

Form-L 200 is said to be pliable enough to be molded into anything from a store mannequin to a bookshelf, free-form furniture to luggage shells. Only ¼-in. thick, it can be die-cut, perforated, printed, coated; won't cold-flow or bleed. And because of the way it's made, it can be deep-drawn (as neither asphaltic nor panel boarding can).

Key to Form-L 200 is the way in which the webbing is created on the paper machine. Instead of resin-impregnating the paper after it comes off the machine (this just pokes clumps of resin between the fibers, which spring loose with flexing), Mead coats each individual fiber with resin before the webbing is matted up. The resin is described only as a thermoplastic, though not a phenolic. Matting ratio is about 80:20 fiber to resin.

Still in development at the company's new Chillicothe, Ohio, laboratories, the forming board will probably be pegged at 17¢/lb. (vs. 20¢ for polystyrene, 28¢ for polyethylene).—**The Mead Corp., Akron, Ohio.** **78B**

Stack coating

Lining keeps H_2SO_4—even HF—exhausts from eating steel flues.

Designed specifically to prevent acid corrosion from high-sulfur fuel exhausts, Stackfas is a solvent-type, black but nonasphaltic mastic. It's effective from −10 to 350 F. on virtually all chimney and flue constructions (steel, concrete, brick, tile)—even against hydrofluoric and hot sulfuric acids.

Sprayed (Stackfas #60-44) or troweled on (#60-45 and 60-46), the mastic takes 8 hours to touch-dry, about a month before it's permanently set. Newly poured concrete can be treated over a black primer coat of Stackfas #51-06 curing agent, which touch-dries in an hour and through-dries in 6-8 hours. The primer contains about 34% solids by volume; the mastic itself has 73% (#60-44 and 60-45) or 83% (#60-46).

Since the preparations contain a volatile, flammable solvent, stacks to be coated must be both cool and ventilated. The chemistry of Stackfas is still closely guarded. —**Benjamin Foster Co., Philadelphia.** **80A**

Polyethylene

Tougher polymer is designed for thin-walled, cellular insulation.

A honeycomb of spherical gas cells, uniformly dispersed within the extruded material, is the key to this polyethylene. Tougher than previously available plastics for cellular extrusion, this polymer has a higher tensile strength at 30% cellular composition than does solid polyethylene electric and telephone cable insulation. At the same time, it retains the solid structure's low-temperature flexibility.

Called Bakelite DGDA-2580, the cellular material has a relatively low dielectric constant (1.5-1.7, compared with a typical low-density polyethylene value of 2.28), thus permitting telephone single-wire insulations with reduced wall thicknesses. Furthermore, since less outer jacketing is required for an over-all cable, more cable can be wound on a reel. Taken from a cost angle, solid polyethylene would cost $1.28/mi. to insulate a single wire, while DGDA-2580 costs 82¢/mi.

Cellular construction of the material doesn't affect polyethylene's well-known moisture resistance, for each spherical gas cell in DGDA-2580 is encapsulated by a shell of polymer. No straight-through gaps are created. Tensile strength of the cellular polymer is 3,000 psi. (that of solid, low-density polyethylene is around 2,200 psi.).—**Union Carbide Plastics Co., New York.** **80B**

Catalyst

Stannous oxalate effects trans- and polyesterification reactions.

Direct trans-esterification (i.e., ester interchange) is an economical route to linear polyesters. The ease of trans- or polyesterification varies widely from system to system, but a metallic catalyst such as stannous oxalate (SnC_2O_4) is both effective and versatile in forcing the reaction. Stannous oxalate is now available commercially.

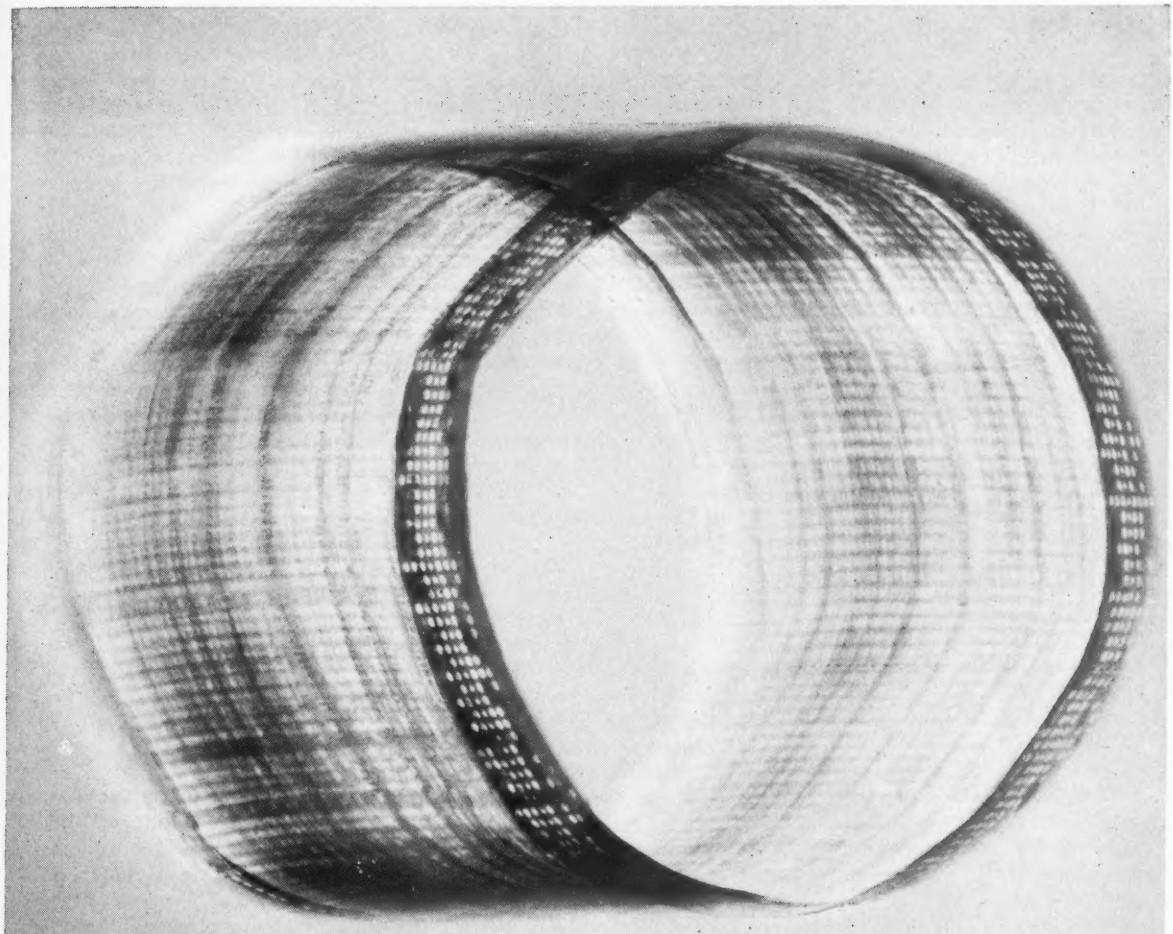
The white powder is slightly soluble in solutions of ammonium chloride and ammonium oxalate; soluble in oxalic acid; insoluble in toluene, acetone, water, ethyl ace-

Newsworthy Chemicals

Page number is also reader service code number

Fire extinguisher snuffs out its own theory.....78A
Nonasphaltic forming board is stretchy.....78B
Stack coating protects against acid-laden fumes.....80A
Tougher polyethylene has cellular construction.....80B
Stannous oxalate catalyst promotes polyesterification.....80C
Black polyurethane elastomer offers long pot life.....82A
Wood preservative nips decay and termite attack.....82B
Four new polyester plasticizers make polyvinyl chloride.....82C
Pearlescent polypropylene comes in rainbow of shades.....82D
Purer urea is a free-flowing prilled grade.....82E
Barium fluoride is doped with assorted rare earths.....82F
Highly pure caustic potash comes as pellet or flake.....82G

For more details use Reader Service Card



YOUR ORDER MOVES AT CRANE

ANY STOCK VALVE ORDER—ANY SIZE—SHIPPED WITHIN 24 TO 72 HOURS!

Crane has put electronics to work on your valve orders. Crane's new high-speed order system links distributing and manufacturing centers with special telephone circuits, then uses punched tape and electronic computers to move any order for stock valves—however large—almost before the ink has dried!

Crane's newly-installed 100-million-digit-capacity computer also makes sure regular valves are in stock when you need them. It keeps track of more than 10,000 varieties of finished and semi-finished valves—38,000 different assemblies, sub-assemblies and raw materials. The punched tape that speeds the processing of your shipment within 24-72 hours also checks inventories automatically, and writes production orders to keep stock levels ready to meet any demand.

No one likes rush orders, but when they become necessary, you can count on Crane for even faster service.

For fast delivery of Crane precision-built valves, see your Crane Distributor or write Crane Co., Industrial Products Group, 4100 S. Kedzie Avenue, Chicago 32, Ill.

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CRANE

valves
piping • electronic controls
plumbing • heating
air conditioning

tate, dioctyl phthalate, tetrahydrofuran, and isomeric heptanes. The solid form decomposes at 280 C., has a density of 3.56 g./cc.

Two esterification reactions in which stannous oxalate appears to be a particularly effective catalyst are neopentyl glycol-adipic acid, and phthalic anhydride-isooctyl alcohol.—**Metal & Thermit Corp., New York.** 80C

Polyurethane elastomer

Black formulation offers long pot life, high tensile strength.

Distinguished by its 30-min. pot life at 60 F. (15 min. at 77 F.), thus providing the time to pour void-free objects of large dimensions, this black polyurethane elastomer sets in an hour, cures in a day.

The system is two-component, formed of the polyol (Urapol 821A) and prepolymer (Urapol 800B). The cured elastomer has tensile strength yet resilience; resistance to tear, abrasion, compression set, ozone, low temperature, oils and solvents.

Viscosity is low—20-25 poises at 77 F. Bubble porosity is said to be nil in hand mixes, and duplication of detail is assured. Virtually no air entrapment is said to result either from hand mixing or a slow-speed blender.

Uses are predicted in molded rubber goods, core boxes, cement forms, potting, encapsulating and the like.—**Poly Resins, Sun Valley, Calif.** 82A

Wood preservative

Decay, termite attack are nipped by pentachlorophenol treatment.

Pressure-treated with liquefied pentachlorophenol, wood becomes water repellent, resistant to decay and insects. But it retains all the other properties of untreated wood (takes glue, varnish and paint, has no odor, isn't discolored, etc.).

Dubbed Cellon, treated lumber or plywood has about 0.3 lb. of crystalline pentachlorophenol deposited among its fibers in each cu. ft. of board. Deep penetration is achieved by impregnation in a pressure vessel, the preservative being carried in liquefied petroleum gas.

Since pentachlorophenol is insoluble in water, it can't be leached. And because its vapor pressure is very low, it evaporates at an extremely slow rate (10% in 50 yr. at 68 F.).

The preservative process itself was first announced this spring (*Chem. Eng.*, May 15, p. 80). Pilot-plant quantities of Cellon woods are now being sold competitively with other preserved boards, and Koppers Co. states in its first-quarter report to stockholders that it expects to have "at least two plants producing this material in volume by the end of the year."—**Koppers Co.'s Wood Preserving Div., Pittsburgh.** 82B

For more information about any item in this department, circle its code number on the Reader Service Postcard (Page 189).

Plasticizers

Four new polyester plasticizers make polyvinyl chloride resins.

Now commercial from the ozone oxidation routes of Emery Industries, Plastolein 9730, 9722, 9750 and 9765 are the newest bidders for the polyvinyl chloride plasticizer market. Theoretical molecular weights are 1,100, 1,000, 2,200 and 3,500, respectively. Features include low cost, migration and soapy-water resistance, reduced losses to extraction media, less outdoor aging than monomeric plasticizers.

Plastolein 9730 (its development label was Emery 3311-D) is the least expensive of the four—in fact, it's said to be the lowest-cost plasticizer now on the market. It's suggested for tapes, vinyl-to-metal layers, coated fabrics, shoe constructions, etc.

Plastolein 9722 (Emery 3282-D) is aimed at vinyls that go into laminates, furniture and automotive coated fabrics, other permanent coverings. Plastolein 9750 (Emery 3313-D) is a general-purpose, semi-resinous plasticizer with particular resistance to hydrolysis. And Plastolein 9765 (Emery 3314-D) has a low odor level, is suitable for such diverse systems as refrigerator gasketing, heavy-duty upholstery.

None of these polymeric plasticizers can be distilled. Flash points are 510, 510, 535 and 530 F., respectively; viscosities (in centistokes at 100 F.) are 1,100, 411, 1,180 and 3,100. A battery of extensive tests has been run on all four, the graphed and tabulated results of which are available in detail. — **Emery Industries Inc., Cincinnati.** 82C

Briefs

Pearlescent polypropylene is available in a wide range of shades, dependent on the size and shape of the piece to be molded. High-luster cosmetic closures, bathroom hardware and other polypropylene consumer items are envisaged by the manufacturer.—**Enjay Chemical Co., New York.** 82D

Purer urea in free-flowing prilled form is now being sold as Chemical Grade for slightly more than Technical Grade, comes from a Stora-Vulcan evaporator in a new process that prevents biuret formation. — **Sohio Chemical Co., Cleveland.** 82E

Barium fluoride, doped with assorted rare earths and transition elements, is the newest laser material. Single crystals measuring 1 in. long by ¾ in. in dia. cost $400 apiece, with chips available to laboratories at $15 each.—**Semi-Elements Inc.'s Single Crystal Div., Saxonburg, Pa.** 82F

Highly pure caustic potash comes in pellet or flake form, contains less than 0.005% sulfates and less than 0.001% Fe and Cl.—**A & S Corp., Randallstown, Md.** 82G

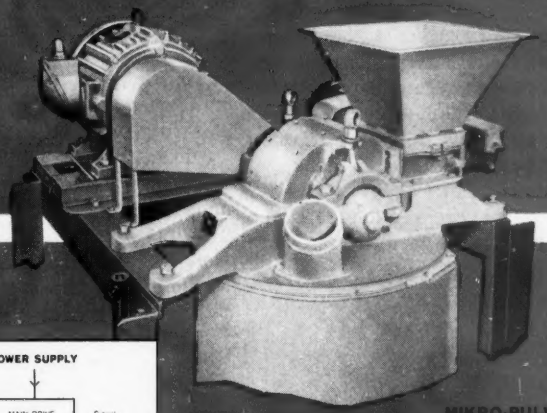
Economize!

AUTOMATED...GRINDING AT MINIMUM COST...

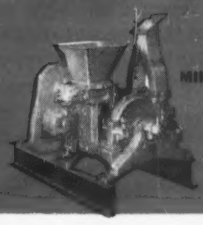
with the

NEW MIKRO-MONITOR

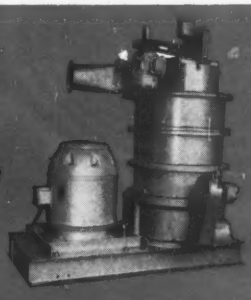
Automatic Load Control • Specifically Designed for



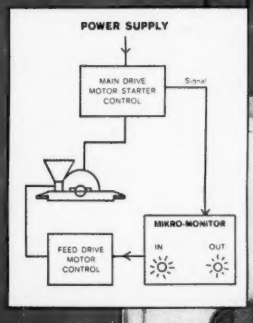
MIKRO-ATOMIZER

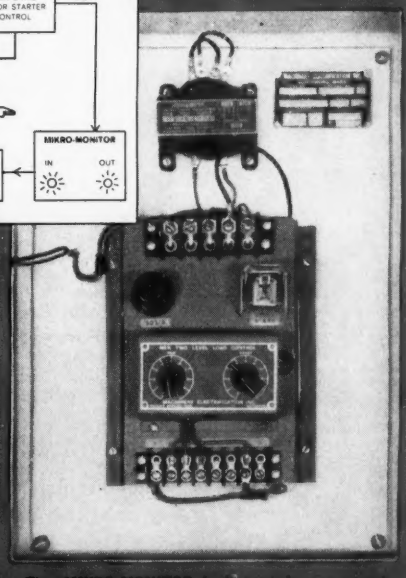


MIKRO-PULVERIZER



MIKRO-BUD





The MIKRO-MONITOR is housed in a compact 12" x 6" x 17" steel wall cabinet, with pilot lights on cover to indicate flow conditions.

- **Increased output up to 25 per cent.**
- **Constant operation.**
- **Virtually no supervision.**

Designed to prevent overloads automatically, by off-on control of the feed motor as a function of the main motor load, the MIKRO-MONITOR assures uninterrupted processing and greatly increased production. Easily installed, the new unit was developed specifically for use with the MIKRO-PULVERIZER, MIKRO-ATOMIZER and MIKRO-BUD, allowing any of these units to be operated for long periods without supervision. Up-date your present Mikro equipment! Write for details on the MIKRO-MONITOR.

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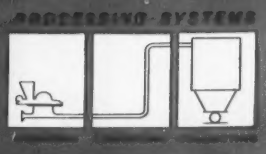
SPAN THE GLOBE

PROCESSING SYSTEMS



HIGH-SPEED EXPANSION TURBINE SPINS OUT LIGHT MATERIALS

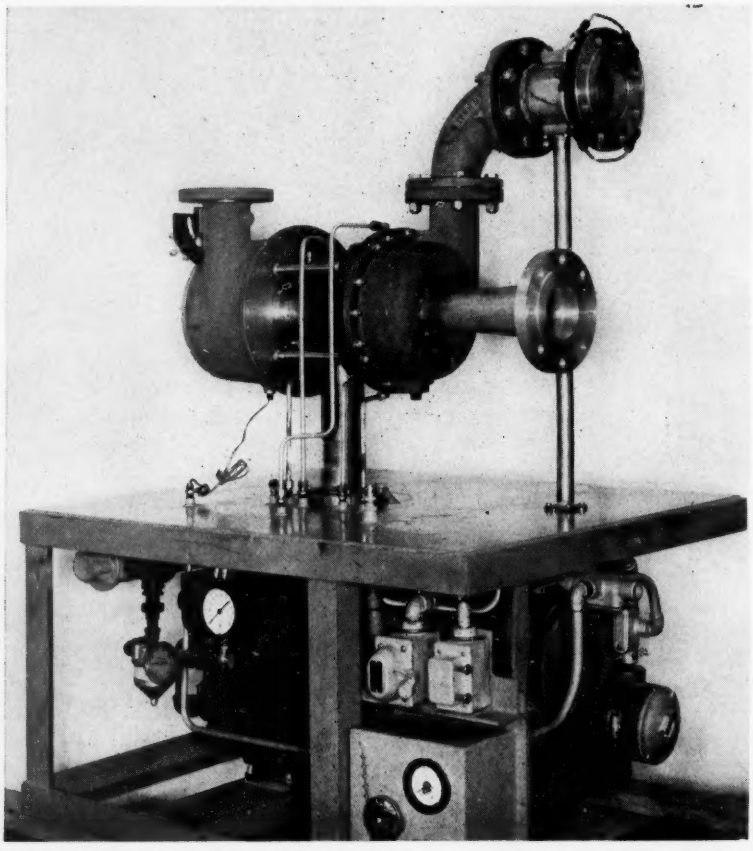
Unit refrigerates while decompressing, separates light hydrocarbons as liquid and discharges them. Concurrently, power is recovered.

Spinning at speeds as high as 100,000 rpm., an expansion turbine, previously used principally for cryogenic applications, can serve a variety of other industrial uses in temperature ranges from ambient to −200 F.

While air-cycle expanders are generally not competitive with vapor-cycle machinery in the range to −50 F., in some situations the turbo-expander can serve both for cooling, and for concurrent pneumatic transport of fine powders.

In many cases of crushing and grinding, particularly those involving plastics materials, prechilling can enhance crushing and grinding efficiency and promote handling qualities of the materials.

Using deep refrigeration to −200 F., the turbo-expander can recover valuable materials from process and waste streams. Light hydrocarbons, for example, can be continuously separated from cracked natural and petroleum refinery gases, to recover easily-liquefiable combustion gases, provide hydrogen and helium-rich gases for further separation, and supply pure fractions for chemical synthesis. And the power recovered from the expansion can be used to drive compressors, etc.



Model C-TXL 130 can take in 120 cfm. of air at −245 F., 100 psia. and effect one-stage drop to −305 F., 23.8 psia., with 81% thermal efficiency.

▶ **Why Turbo Machinery?** — The main advantage of turbine-type machinery is its ability to handle gases in a continuously steady stream with an almost complete absence of vibration. Since the only points of contacts are the bearings, maintenance is at a minimum. In recent models, turbines avoid even this point of wear by operating on gas bearings.

Another asset of the turbine unit is its size. According to the manufacturer, a machine 2 ft. in dia. and 1 ft. long is capable of passing 5,000 cfm. of gas, which is about five times that possible with a reciprocating engine occupying the same space and weighing twice as much.

This particular unit is designed to remove condensed liquid from the gas stream continuously, without any buildup within the machine that could affect the turbine wheel.

The device also has its limitations. A high-speed disk has high rotational inertia, making it undesirable in applications requiring rapid speed changes. Also, this type of unit is normally unsuitable for intermittent duty. — **Stratos, Div., Fairchild Engine & Airplane Corp., Bay Shore, N. Y.** **84A**

Differential Manometer

Portable unit has 36-psi. range, at working pressures to 2,000 psi.

A mercury-actuated pressure measuring instrument, equipped with miniature scrubbers to maintain clean mercury, is said to have an accuracy of 0.01 psi., in measuring differential pressures to 2,000 psi.

This reasonably high accuracy is attributed to the design that insures that the level of mercury in the reservoir is constant during

HOW YOU CAN PUT TELEVISION TO WORK

A brief report on how to use KIN TEL closed circuit TV systems to cut costs, reduce errors, up efficiency

Today, hundreds of companies are solving a wide variety of business and industrial problems with KIN TEL closed circuit TV systems.

For example:

U. S. Steel uses a KIN TEL system to see inside open hearth furnaces.

The Los Angeles Department of Water and Power uses one for remote viewing of water-level meters.

Convair, Douglas, Lockheed, and Northrop all watch rocket tests with KIN TEL systems.

Westinghouse watches nuclear power reactor tests with one.

American Potash and Chemical monitors conveyor line and warehousing operations with one.

The San Francisco Naval Shipyard uses one to guard against pilferage.

These, and many other KIN TEL customers—both large and small—have discovered a significant fact: *Closed circuit television is no longer a novelty.* It's a proven, practical piece of equipment that, in many instances, pays for itself within a year. It's a modern, money-making piece of equipment that you can use in your business, in your plant, in your operation.

What Is a Kin Tel Closed Circuit TV System?

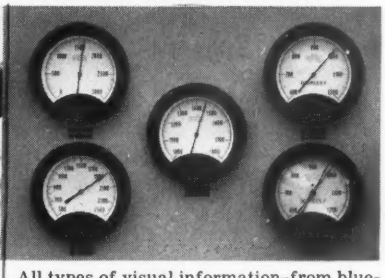
The basic system manufactured by KIN TEL consists of a rugged yet sensitive camera that is small enough to hold in your hand; a receiver that displays pictures that are twice as sharp as you can get on your home TV set; and a camera control unit that is so automatic the only control you have to touch is the on-off switch.

More Than Likely, Your Business Can Use Such a System.

You can use one to watch events or operations that are tedious, difficult, dangerous, or even impossible for men to watch.

Dependable KIN TEL TV systems see where men cannot survive; withstand tremendous extremes in temperature and pressure; perform both critical and routine jobs inexpensively, faultlessly, safely, tirelessly.

You can use one for data transmission.



All types of visual information–from blueprints to fingerprints to graphs–are transmitted over great distances quickly, accurately. Such systems save money, reduce errors and confusion, speed operations.

You can use one for surveillance work.

KIN TEL cameras scan vast areas; guard valuable equipment and property; never blink, quit, sleep, or make an error; watch many operations at once; transmit all information to a central monitoring point.

You can use one for on-the-job training.

Students study operations viewed by a KIN TEL camera. Such systems permit mass teaching that gives each student an unobstructed view; provide on-the-spot realism; end expensive, disturbing plant tours.

Here's What a Kin Tel System Can Do for Your Business

It can do what it is doing, right now, for hundreds of other firms. It can increase the over-all efficiency of your entire operation. It can help you tighten production and inventory controls, help you better your services to customers and clients. It can reduce errors and confusion and duplication. It can cut costs. It can save you time and money. It can free valuable men from tedious and routine tasks. It can give you the modern tools you need to keep pace in this highly competitive market.

For a more specific analysis of how KIN TEL TV can go to work for you, write direct for catalog 6-103 and the name of your nearest KIN TEL engineering representative.

8 Reasons Why So Many Firms Insist on Kin Tel TV Systems

1. Reliability. KIN TEL equipment is designed to keep working, day in and day out. It's the first choice for ICBM and other missile programs that depend on TV, that can't afford to compromise with reliability.

2. Picture Quality. Full 650-line resolution provides maximum delineation, essential for qualitative observation of complex operations, and for transmission of printed material.

3. Automatic Operation. KIN TEL TV is the only closed circuit system that provides entirely automatic, through-the-lens compensation for light-level changes of several thousand to one.

4. Sensitivity. With KIN TEL equipment, the light needed to read this page is enough for sharp, clear pictures; and usable pictures can be provided with less than one foot-candle illumination.

5. Ease of Installation. No site preparation is needed, no interacting electrical adjustments are required. All units fit in standard 19-inch racks.

6. Simplicity of Operation. With no changes in lens iris to make, the only thing the operator has to know is the location of the on-off switch.

7. Adaptability. A complete line of shelf-item system components and a variety of cameras and monitors permit observations of nearly every kind of operation, under all kinds of conditions.

8. Application Help. You don't have to waste your money and time on application engineering. At no obligation, KIN TEL's nationwide factory-trained field engineers will determine whether or not a TV system can be put to profitable use in your intended application.

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A DIVISION OF
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KIN TEL—pioneer and leader in closed circuit television

all measurements. The instrument has two scales: 0-1,000 in. H_2O and 0-36 psi. It may also be used as a deadweight pressure gage in the low-pressure range.

Called the Topazmeter, the device serves for measuring pressure drop across piping and equipment, for calibrating and adjusting gages, regulators and pressure-relief valves, and as a displacement meter.

Equipped with a metal carrying case, the unit may be permanently mounted or taken to remote locations. With special adaptation, it can handle pressures to 5,000 psi. **—ToPaz, Inc., Houston. 84B**

Bellows-seal valve

Unit isolates dangerous fluids at extreme temperatures, pressures

A bellows-seal valve with forged stainless steel body can handle rare and/or dangerous fluids at high temperatures and pressures, and in high vacuum and cryogenic systems. The standard line includes gasketed and welded valves.

For extra safety, union-bonnet construction is combined with back-seating and a secondary packing system. Every valve is helium leak-tested, with a maximum allowable leakage of 0.0005 micron/cu. ft./hr.

The high-pressure version, HY-473, is rated to 2,000 psi. at 600 F. The LY473 serves up to 400 psi. at up to 350 F, and has replaceable Teflon seats and gaskets.—**Hoke, Inc., Cresskill, N. J. 86A**

Low-flow regulator

Device automatically controls liquid flow rates from 0.1 to 3.0 gpm.

Where a constant small flow is needed, the Fix-a-Flo regulator will control the rate within ±5% of the set point. A piston-and-spring operation eliminates diaphragms and pressure connections, allows the unit to be installed in any position without need for straight pipe runs either up or downstream.

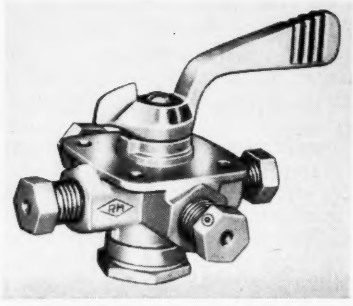
Made of Type 18-8 stainless steel, it will withstand an internal pressure of 1,000 psi., operate at 9 psi. or less. Inlet-to-outlet pressure drop is a maximum of 125 psi. Half a turn on an adjusting screw can set the flow rate from 0.1 to 3.0 gpm.—**The W. A. Kates Co., Deerfield, Ill. 86B**

Gas detector

Dry-cell instrument indicates concentration of flammable gases.

Standing guard to protect against hazardous conditions developing from gas leaks or other emergency situations, a safety device called the Gas-O-Larm Detector can indicate the concentration of any flammable gas.

The portable unit contains an electrically operated probe that uses a platinum filament element. The instrument is normally calibrated for methane and ethane but may be calibrated for other gases as desired. Calibration curves are then used to show the actual percentage of the specified gas. — **Beard Instruments, Houston. 86C**



Sampling valve

Unit is designed to take liquid or gas chromatography samples.

Fitting into most fluid-analysis systems, this valve is designed to take gas or liquid samples for gas chromatography analysis from −65 to +250 F. at maximum pressures of 50 psi. (gas) and 90 psi. (liquid). A self-lubricating Teflon plug not only eliminates oil and grease contaminants common to standard valves, but also reduces internal leakage.

Two models are available: a 4-way and a double 4-way (two 4-ways stacked). While a sample is being taken into one loop of the 4-way valve, the sample in the other loop may be carried into the chromatograph. One port has an adjusting feature that permits balancing of loop volumes.

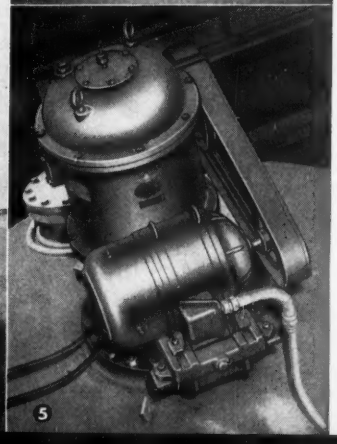
Port connections are for unflared ⅛-in. tubing with O-ring compression seal. — **Republic Mfg. Co., Cleveland. 86D**

Metering pump

Corrosive fluids handled up to 1.75 gph. at 212 F., 300 psi

With higher capacity than former units of the same size, this metering pump can serve as a sampler, proportioner, filling machine, chemical feeder, pump,

Improved Processing through Engineered Agitation



HOW IMPORTANT IS GOOD FLUID MIXING IN YOUR PROCESS?

REGARDLESS OF HOW SPECIALIZED your particular processing needs are, good mixing can be the difference between "run of the mill" and maximum yields.

NETTCO MIXERS ARE PROCESS-RATED for optimum performance. Your particular process requirement is fully evaluated. And—it costs no more to get the full benefit of Nettco's wealth of agitation technology and broad application experience. Then—from design and pilot test to full process conditions, standard components are precision teamed to provide you with a Nettco mixer to meet your most exacting conditions. If good fluid mixing is vital to your process, then Nettco Engineered Agitation is vital to *you!*

PUT NETTCO ENGINEERED AGITATION TO WORK FOR YOU. From a full line . . . side drive, tank top, portable or tripod and unique continuous pipeline mixers, NETTCO can provide the answers to a wide range of mixing problems. See your NETTCO representative listed in Chemical Engineering Catalog or Refinery Catalog, or write for Bulletin 581, NETTCO CORPORATION, 87 Tileston Street, Everett 49, Mass.

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ENGINEERED AGITATION SPECIALISTS
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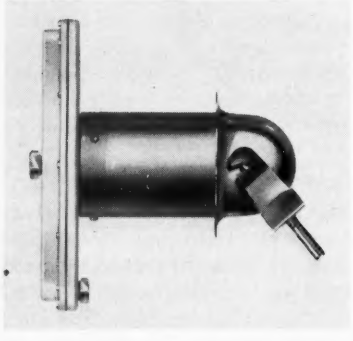
1. Paint blending with Nettco tank top mixers on 400 gallon portable tanks.
2. Nettco Flomix® in the continuous recycling of waste product to improve yield.
3. Variable speed pilot plant application of Nettco medium speed, propeller drive mixer.
4. Raw material batch blending with Nettco side drive mixer to assure uniformity.
5. 15 year old Nettco tank top mixer for synthetic rubber production with one of first double mechanical seals.

or as a means for fluid control by responding to instruments that are measuring process variables.

The device, like its predecessors called Pulsafeeder, is a positive-displacement pump in which a reciprocating piston forces hydraulic fluid to move a diaphragm forward and back. The diaphragm isolates the chemical being pumped within the head plate and check valve area, hence only these parts need be made of corrosion resistant materials.

Maximum capacity is 1.75 gph., with pressure rating to 300 psi. Length of piston stroke is adjusted by a micrometer dial, mounted externally, that provides changes in increments of 1/1,000 of maximum output while the pump is operating or idle.

Liquid handling parts are of Carpenter No. 20 stainless steel; diaphragm may be Kel-F, Teflon or stainless steel.—**Process Equipment Div., Lapp Insulator Co., LeRoy, N. Y.** 86E



Tank gage

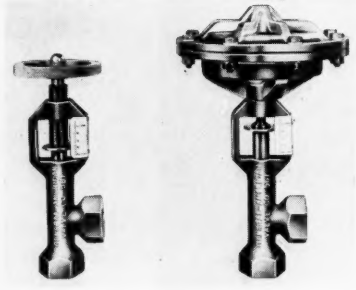
Tank contents are indicated directly on a circular dial.

The level of liquid contents in tanks and vessels is shown on a dial-and-pointer indicator, part of a float-type gage that serves for applications up to 1,000 psi.

Float movement is transmitted through the arm to the indicator via a magnetic coupling, with an accuracy of 0.5%, according to the manufacturer. Parts within the tank are made of Type 316 stainless steel for service with corrosive materials.

Marked in either gallons or pounds, dial graduations values may be calculated from tank dimensions or developed from actual calibration of the tank.—**The Liquidometer Corp., Long Island City, N. Y.** 88A

For more information about any item in this department, circle its code number on the Reader Service Postcard (Page 189).



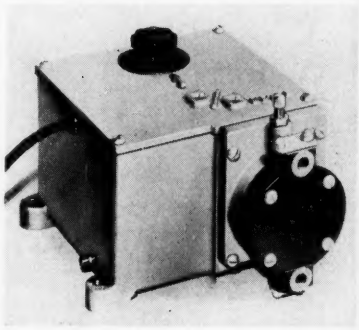
Indicator valve

Outside indicator allows orifice position to be seen easily.

With an indicator located next to the stem on this all-purpose valve, the amount of orifice opening can be easily seen, and repetitive valve settings can be made with reasonable accuracy. Unit may be locked in any position with an optional locking handle.

Threads are located outside the packing, never come in contact with the flowering medium. O-ring packing reduces interior dead space, makes the valve particularly suitable for handling solutions that solidify or precipitate.

Sized from 1/8 to 4 in., valve is available with various tips and seats such as needle point, V-groove and Micro-Flo (for ultra-fine flow). Rated to 10,000 psi., valve is available in either manual or air-actuated types, comes in stainless steel, bronze, or carbon steel with stainless steel trim.—**Flow Systems, Inc., Corona del Mar, Calif.** 88B

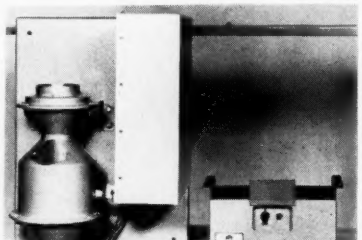


Metering pump

Precision instrument controls liquid flow in low range.

As a portable unit in the laboratory or a permanent part of a pilot plant, this metering pump provides precision flow control from 0 to 2.5 gph. The volume of flow is adjusted by turning a micrometer-type dial.

Contamination danger is minimized by plastic construction of the pump head (polyvinyl chloride), diaphragm (Teflon) and check valves (Hypalon). Priced from $260-330, this line of pumps features two other models with capacities from 0 to 1.6 and 0 to 0.2 gph.—**Cole-Parmer Instrument & Equip. Co., Chicago.** 88C



Solids flow meter

Compact unit measures weight of dry material up to 3,500 lb./min.

Whether the stream to be measured is 5 or 3,500 lb./min., a motorless dry flow meter will tally its weight with an accuracy said to be ±1%. Flow pressure is converted to electrical current for

New Equipment continues on page 172

The design . . . the tanks . . . the hull . . . all by American Bridge

Complete barge construction service—from design through delivery—is available from American Bridge at three strategic locations: Ambridge, Pa., Orange, Texas, and Trenton, New Jersey.

And at Orange, we have the facilities to construct and install pressure vessels and special steel tanks to handle most any chemical. The barge shown above was built at Orange. It is classed by the American Bureau of Shipping to ✠A1 Pressure Tank Barge, River Service, and is certified by the U. S. Coast Guard for transporting liquid chlorine in bulk, inland service. This barge can carry 123,000 gallons of liquid chlorine each trip—enough to purify the drinking water for a city the size of Pittsburgh, for 8 years!

Let us take care of your water transportation equipment needs. Just contact our Marine Department, Ambridge, Pa., or any of our district offices.

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NIGHT AND DAY

twenty-four hour service

PUMPS • WATER WELLS • WATER TREATMENT

Layne knows that an unfailing supply of water is vital, whether it be for municipal, industrial or agricultural use. With Associate Companies located throughout the world, Layne can provide the speed, the trained technicians and the quality parts to remedy your water problem. Over 75 years of experience accounts for the ever increasing list of customers who depend on Layne for service. For service night and day, call the Man From Layne.

Write for Layne Service Bulletin 100.

LAYNE OFFERS COMPLETE WATER SERVICE: Initial Surveys • explorations • recommendations, site selection • foundation and soil-sampling • well drilling • well casing and screen • pump design, manufacture and installation • construction of water systems • maintenance and service • chemical treatment of water wells • water treatment—all backed by Layne Research. Layne services do not replace, but coordinate with the services of consulting, plant and city engineers.

LAYNE & BOWLER, INC., MEMPHIS

General Offices and Factory, Memphis 8, Tenn.

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

SALES REPRESENTATIVES IN MAJOR CITIES

PLATECOIL built into side of processing tank
Type of PLATECOIL used for temperature control of missile fuel.
Chemical processing tank equipped with bank of PLATECOIL to give maximum cooling surface
PLATECOIL rolled and fabricated into cylinders

PLATECOIL®

SOLVES TANK AND PROCESS HEATING AND COOLING PROBLEMS

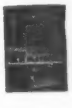
These are but a few examples of hundreds of PLATECOIL which have been especially formed and fabricated to meet a processing or manufacturing requirement. Today, in addition to standard styles (which in themselves offer a broad range of application possibilities) PLATECOIL can be rolled, formed and shaped to satisfy rigid requirements of space, configuration, weight and materials.

PLATECOIL saves on engineering, fabricating, installing, and maintenance in comparison with pipe-coils. Greater heat transfer capacity permits compact units which save space.

Operating pressure up to 250 psig. Safety factor 5 to 1. Available in stainless steel, mild steel, Monel, Nickel, Inconel, Ni-O-nel, and Hastelloy B, C, and F or other weldable materials on special order.

"PLATECOIL" CAN BE FURNISHED TO COMPLY WITH ASME CODE

BUILT TO SPECIFICATIONS



Send for PLATECOIL® Bulletin P-61.

Tranter Manufacturing, inc.

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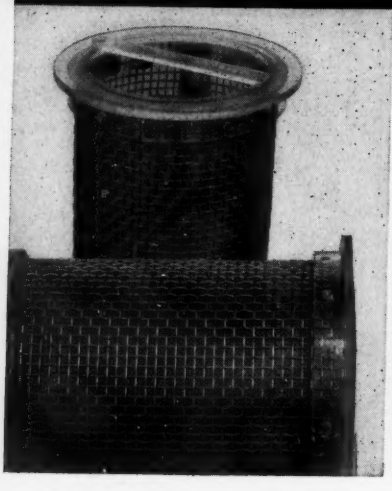
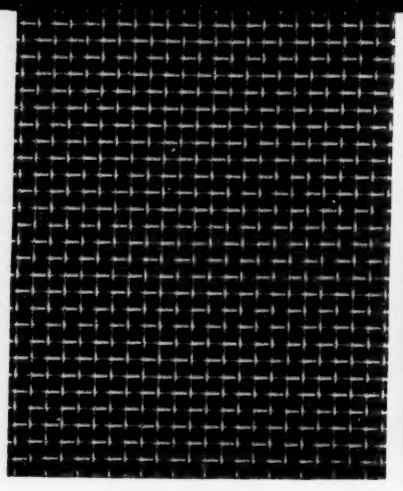
PLATECOIL® DIVISION

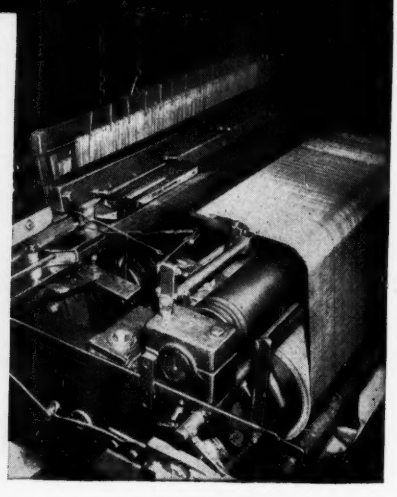
Need Wire Cloth in Special Metals? call *Cambridge*



HASTELLOY C*



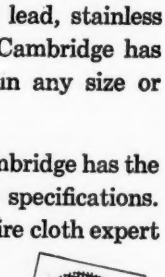
SILVER



TITANIUM

Working with unusual metals or alloys—as well as with standard metals and alloys—is almost an everyday occurrence at Cambridge. For instance, not too long ago, we developed the first practical method of weaving titanium into wire cloth—with mesh counts far higher than had been expected by the customer. Platinum, lead, stainless steel, or bronze—whatever the metal or alloy used, Cambridge has the experience and facilities to produce wire cloth in any size or quantities to the closest tolerances.

If you require fabrications—of any shape or size—Cambridge has the craftsmen and know-how to fill even the most rigid specifications. Or, we'll draw up prints for your approval. There's a wire cloth expert near you—ready to discuss your needs and show you how to get what you want economically and on time. He's your Cambridge Field Engineer... and his name is listed in the Yellow Pages under "Wire Cloth." Or, write for our illustrated, 120-page catalog.



Refer to our technical data sheets in CHEMICAL ENGINEERING CATALOG, Page 185

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Manufacturers of Wire Cloth, Wire Cloth Fabrications, Metal-Mesh Conveyor Belts and Gripper® Metal-Mesh Slings.

*Reg. T.M. of Union Carbide Co.

ECO ENGINEERING NEWS

the big name in small pumps for the process industries

Who Pumps What with ECO

Butyl chloride. A major refiner of light metals and chemical producer uses Hastelloy* C GEARCHEM Pumps with Penton× spur gears to pump butyl chloride.

Hexachloropentadiene. The Royal Dutch Shell Co. in Holland pumps hexachloropentadiene with a GEARCHEM Pump constructed of nickel with Teflon† gears.

Calcium chloride brine. Pumping calcium chloride brine at −60° F is the chilly job of 316 stainless steel GEARCHEM Pumps with Teflon gears at the New England plant of an electronic tube manufacturer.

Potassium sulfite slurry. An industrial research laboratory handles a four percent slurry of potassium sulfite at 300° F with a pedestal-mounted CENTRI-CHEM Pump in Carpenter 20 stainless steel with semi-open impeller.

Hot caustic. A leading manufacturer of synthetic textiles required an Eco GEARCHEM Pump with nickel housing and Hastelloy C gears to pump 73 percent caustic at 259° F against 75 psi.

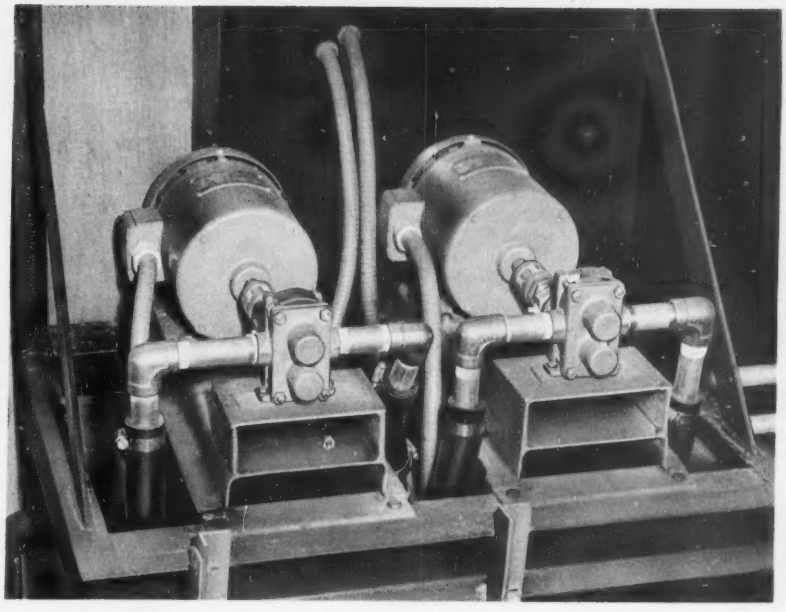
DuPont acrylic resin RK-6305. Major electric motor manufacturer uses Eco GEARCHEM Pumps to move DuPont's acrylic resin RK-6305. The resin is diluted but still has a viscosity of 600 SSU when handled by the Eco Pump. Also, most electrical manufacturers (names on request) also use this same pump in 316 stainless steel with Teflon gears to pump DuPont's ML Polymer Wire Enamel.

And Here are a Few "Wide and Outside"

All within a day, bonafide orders for these following pump applications arrived by post, phone and telegram.

Problem	Answer
Cyclopentadiene	Nickel Gear Pumps
Di-methyl formamide & Toluene	316 SS Gear Pumps
Lithium-Bromide	Nickel and Stainless Pumps with Rubber Gears
Polyvinylalcohol adhesive, 1800 Cps Vis	316 SS Gear Pumps
Methane Diamine, viscosity of about 100 Cps	316 SS Gear Pumps
Toluene Diisocyanate	316 SS Gear Pumps
Triethyleneglycol-diacrylate	316 SS Gear Pumps
Methylisobutylketone	316 SS Gear Pumps
Monoethanolamine	316 SS Gear Pumps
Monochlornaphthalene	316 SS Gear Pumps
Peracetic Acid	316 SS All-Chem Pumps

This is highly explosive and detonation prone.



Plating the Pictures for New York Newspapers

Garden Photoengraving Co., Mineola, N. Y., specializes in fast, overnight service in preparing zinc plates for lithographic reproductions in metropolitan New York newspapers. Using the Dow powderless etching process, this plant consumes an average of 40 gallons of 42° Baumé nitric acid per 2 shifts each night.

Formerly, the concentrated acid was purchased in stainless steel carboys of sizes weighing 165 to 600 pounds. Handling the carboys of HNO_3 was not only back-breaking work, but was also dangerous and costly. Mr. Leon Standley, President of Garden Photoengraving, investigated the economics and feasibility of bulk purchases of nitric acid and learned that the resulting savings in the cost of the acid would pay for the necessary safe handling system within a year's time. In fact, the refunded deposits on the stainless steel carboys paid for one of the two 1200-gallon stainless steel acid storage tanks installed just outside the etching room to receive the bulk acid by tank truck shipment.

From there on, two 316 stainless steel GEARCHEM Pumps with Teflon Gears and special grease sealed lantern ring stuffing boxes, illustrated above, draw the acid from outside storage tanks and transfer it, as needed, to the four head tanks—from which it flows to two holding tanks in constant temperature baths which maintain the acid at 70° F for subsequent safe dilution with water and organic chemicals. Then a ⅜" GEARCHEM Pump transfers the acid to a measuring tank where it is diluted to the proper concentrations and from which it flows by gravity to the etching machines as needed.

Plates are etched in three Chemco machines, and in each machine the etching solution is recirculated by Eco CENTRI-CHEM Pumps installed as original equipment by Chemco Co., Glen Cove, N. Y. Thus there are six Eco pumps handling nitric acid daily for Garden Photoengraving.

Pleased plant engineer Ed Klemert says of the new system, "Now Eco does the lifting." All anyone has to do to fill the head tanks is push a button. And when the plant is particularly busy at night, it is no longer necessary for the etchers to draw a pitcher or two of concentrated acid from the awkward and dangerous carboys to finish their work. Instead they, too, can simply push a button and have the Eco Pumps handle the acid for them.

*Union Carbide Trademark. †du Pont Trademark. ×Hercules Powder Trademark.

ECO ENGINEERING NEWS

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Needing large amounts of hydrofluoric acid to process the high purity metals and to make these rare metal fluorides, Kawecki engineers ran into the usual difficult corrosion problems associated with handling HF solutions. Pumps transferring cold, 70 percent solutions of HF against heads to 40 feet lasted only six months at the most. But then Kawecki learned that Eco offered a GEARCHEM Pump in Hastelloy C with carbon bearings and wear plates that was highly recommended for handling HF under similar conditions existing in their Boyertown, Pa. processing plant.

GEARCHEM Pumps were substituted last July, and 10 months later they show no signs of succumbing to the same fate as previous pumps. Besides good service life, the GEARCHEM Pumps have an added advantage for Kawecki for they do not require priming. Previous pump had to be primed with lubricating oil which was potentially detrimental to the high purity of the rare metals and chemicals. By installing GEARCHEM Pumps, Kawecki eliminated the contamination and corrosion problems for good.

Low Cost Flow Control Instrumentation

It has become a known fact that Eco GEARCHEM Pumps with Vickers variable speed transmissions, and equipped with Rotometers can supply highly dependable, precise and reproducible flow control instrumentation at a fraction of the cost of conventional instrumentation and expensive, custom-built metering pumps.

Several outstanding plants are now standardizing upon this Eco-Vickers-Rotometer combination which supplies the linear, constant flow for the essential, dependable metering of a wide variety of media.

New Bulletin on Eco Pump Drives and Accessories

Almost always it pays to use the drives, base plates, couplings and other accessories which have been designed especially for use with a particular pump design—because a great deal of thought and skill has been expended to make such accessories most suitable and adaptable to the various applications of the pump. And, contracted in volume or mass produced at Eco, they are generally more economical to purchase than from any other source (or to improvise in your own plant).

Bulletin PD-760 describes all standard drives for All-Chem, Gearchem, Minilab and Centri-Chem Pumps—direct connected electric motor; air motor; pulley and sprocket drives; variable speed belt, hydraulic and mechanical types. It also features new channel and cast drip rim bases, precision pump mounting blocks, corrosion resistant couplings, portable pumping units, etc.

Ask for your free copy.

KIWI Takes a Shine to Eco Pumps

KIWI Shoe Polish Company of Pottstown, Pa. recently bought another Eco rotary displacement pump in stainless steel with neoprene impellers for handling abrasive titanium dioxide slurry.

KIWI, nationally known and highly regarded member of the spit-and-polish society of meticulous dressers, are well pleased with Eco Pump performance.

900 GEARCHEM Pumps Prove Out in Viscous Service

The brawny member of the hard-to-beat GEARCHEM family, the Series 900 pump is developing an excellent reputation for handling viscous solutions.

Operating at 300 rpm, a Series 900 GEARCHEM pumps a 30 percent solution of sodium lauryl sulfate with a viscosity of 5000 centipoises at 120° F.

Constructed of 316 stainless steel with Hastelloy C dual spur gears and carbon bearings, this pump has 1½ inch ports to move the thick solution at 7 gpm. This top performance is only one example of what the Series 900 GEARCHEM Pumps can do. Providing discharge pressures to 150 psi, they will pump 1000 SSU oils at rates to 27 gpm and will handle higher viscosities to 50,000 SSU at lower capacities.

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The fact that Eco precision, interchangeable parts are always available, in stock, for immediate air delivery, anywhere in the United States, makes possible the confidence with which many users of Eco pumps in remote locations continue to specify them on essential services.

ECO Products for Handling Corrosive and Hazardous Processing Fluids

ALL-CHEM® Rotary Pumps
MINILAB® Rotary Pumps
GEARCHEM® Gear Pumps
CENTRI-CHEM® Centrifugal Pumps
PUMPMOBILE® Portable Pumping Units
GEAR-VAC® Valves
CHEMICAL® DISPENSING VALVES
Factory Mutual Approved

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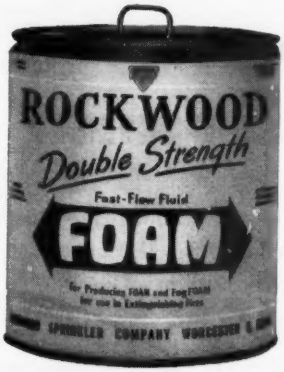
of Rockwood FOAM protection is FREE!



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FOR FIRE FIGHTING purposes Rockwood Double Strength FOAM is inexpensive and completely effective. 3 parts *Rockwood Foam Liquid, plus 97 parts free water, plus 900 parts free air give you a fast low-cost fire extinguishing agent for only 1½ cents a gallon!*

Rockwood Double Strength FOAM puts out fires fast . . . reduces your storage costs . . . reduces shipping costs too! If you're using other types of special hazard fire extinguishing agents — you may not be using the most economical or most effective agent! We'll show you how to save on training cost and on fire fighting costs — and to fight fires better! Send in the coupon below. Tested and listed by Underwriters' Laboratories, Inc. Distributors in all principal cities.

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Please send me complete information on Rockwood fire-fighting products.

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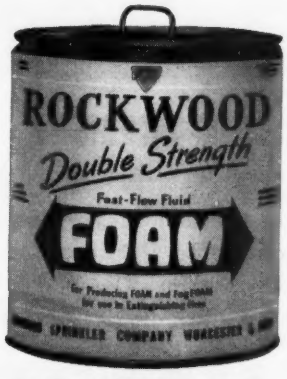
of Rockwood FOAM protection is FREE!



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Rockwood Double Strength FOAM puts out fires fast . . . reduces your storage costs . . . reduces shipping costs too! If you're using other types of special hazard fire extinguishing agents — you may not be using the most economical or most effective agent! We'll show you how to save on training cost and on fire fighting costs — and to fight fires better! Send in the coupon below. Tested and listed by Underwriters' Laboratories, Inc. Distributors in all principal cities.

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Company.....
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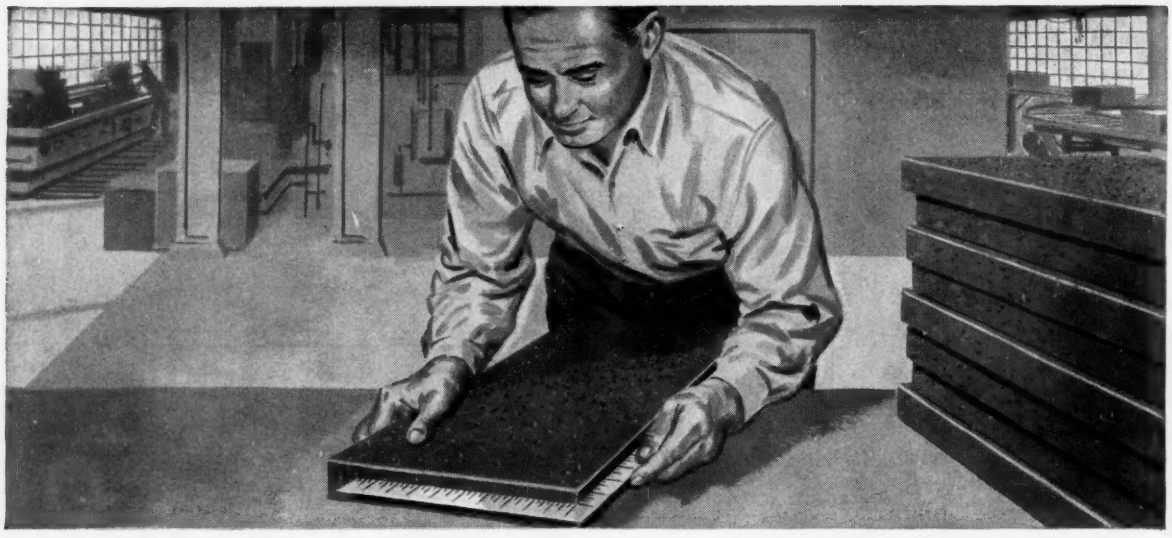
City.....*Zone*....*State*.....



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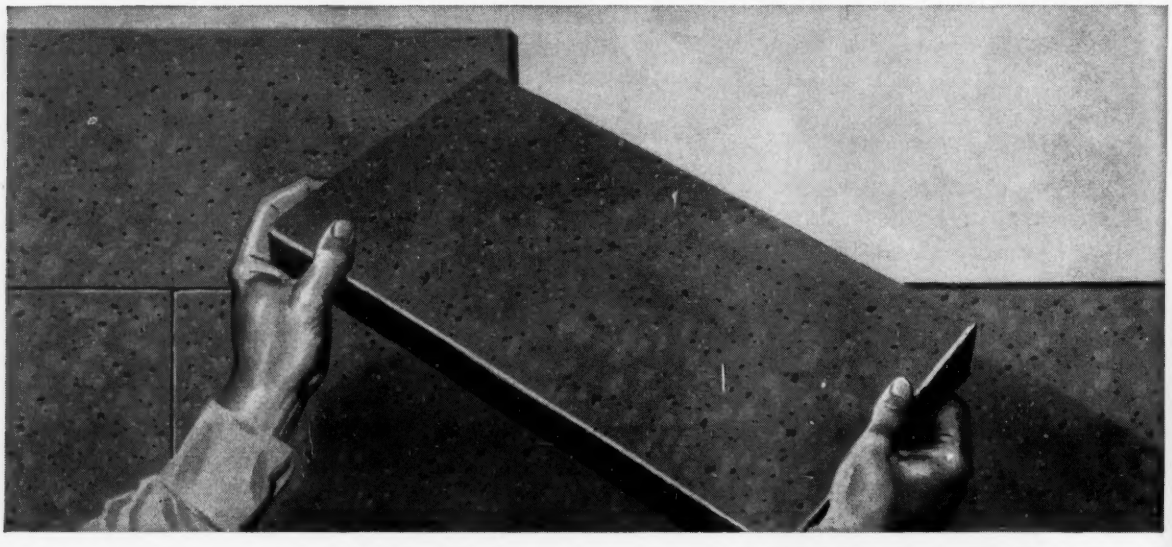

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- Highly efficient, all-purpose block that is practically dustless.
- Great structural strength! Meets rigid demands for long-lasting block able to withstand wide temperature range up to 1900 F.
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BLOCK INSULATION

This Mineral Wool Insulation conforms to COMMERCIAL STANDARD CS-117-49 as issued by U.S. DEPARTMENT of COMMERCE.

Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.

EAGLE-PICHER / Manufacturer's Manufacturer

Since 1843 / The Eagle-Picher Company
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EAGLE EP PICHER

emergency

maintenance fund for DEMING PUMPS

Special maintenance on your Deming pumps probably won't cost you a nickel! Years of trouble-free performance is the rule; emergencies rarely occur.

Dependable Demings save you money in other ways, too. When routine servicing is performed, spare parts inventory is light because Deming parts are standardized and readily interchangeable. Plant expansion costs less because Deming pumps are designed for adaptation to your growth requirements.

Deming rotary and sump pumps, end suction and vertical immersion process pumps are of special interest to the processing industries. For complete descriptive literature, just mail the coupon.

THE DEMING CO.

887 Broadway • Salem, Ohio

Overseas distributorship available in some areas. Write to Department C for details.

Please send me catalogs on: (type)_____ pumps for (application)_____

NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

GAR-LINE PENTON TANK LININGS

for High-Temperature Corrosion Proofing

Can be applied to virtually any surface or contour to give superior, low cost protection against high-temperature corrosion. GAR-LINE Penton Tank Linings are replacing and outperforming more expensive materials in an ever-increasing number of applications.

Serviceable at temperatures up to 280°F, these efficient linings embody outstanding tensile strength, excellent dimensional stability and low water absorption. Chemically, they resist bleaching agents, solvents, plating solutions . . . in fact, all inorganic acids except fuming nitric and fuming sulfuric.

Applied by carefully selected and authorized applicators. The experience of these tank lining experts guarantees satisfactory GAR-LINE Penton installation, prevents expensive failure due to improper application. Approved applicators include:

ABRASION & CORROSION ENGRS.
1205 N. McMasters Street
Amarillo, Texas

ATTBAR PLASTICS
1107 Northeast 106th Street
Vancouver, Washington

BARTHEL CHEMICAL CONST. CO., INC.
P. O. Box 1025, Tacoma 1, Wash.

BITTNER INDUSTRIES, INC.
91 Diaz St., P. O. Box 10265
Prichard, Alabama

BUCKLEY IRON WORKS
21 Christopher St., Dorchester, Mass.

BUFFALO LINING & FABRICATING CORP.
73 Gillette Ave., Buffalo 14, N.Y.

CEILCOTE COMPANY, INC.
4832 Ridge Rd., Cleveland 9, Ohio

CHEMICAL PROOF OF SEATTLE
625 Alaska Ave., Seattle, Wash.

ELCHEM ENGRG. & MFG. LTD.
P. O. Box 249
Burlington, Ontario, Canada

ELECTRO CHEMICAL ENGRG. & MFG. CO.
750 Broad St., Emmaus, Penn.

THE FABRI-FORM COMPANY
P. O. Box 125, Byesville, Ohio

FLORIDA CORROSION CONTROL
P. O. Box 10082, Jacksonville 7, Fla.

THE FORTUNE COMPANY
1100 W. 37th St.—North
Wichita 14, Kansas

GALIGHER COMPANY
545 West 8th–S., Salt Lake City, Utah

GATES RUBBER COMPANY
Denver, Colorado

GOLDEN PLASTICS CORP.
333 East 8th St., Oakland 6, Calif.

GOODALL RUBBER COMPANY
2050 N. Hawthorne Avenue
Melrose Park, Illinois

HANSZEN PLASTICS COMPANY
835 S. Good-Latimer Exprw.
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HEIL PROCESS EQUIPMENT CORP.
12901 Elmwood Ave., Cleveland 11, O.

HUNTINGTON RUBBER MILLS of Port Coquitlam
B.C., Canada

INNER-TANK LINING CORP.
4777 Eastern Ave., Cincinnati 26, O.

MAURICE A. KNIGHT
Kelly Ave., Akron 9, Ohio

MERCER RUBBER CORPORATION
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Little Ferry, New Jersey

METALWELD, INC.
Scotts Lane & Abbottsford Rd.
Philadelphia 29, Pennsylvania

PARKER BROTHERS, INC.
7044 Bandini Blvd.
Los Angeles 22, California

PLASTIC APPLICATORS, INC.
7020 Katy Road, P. O. Box 7631
Houston 7, Texas

PROTECTIVE COATINGS
1602 Birchwood Ave., Ft. Wayne, Ind.

ROANOKE BELTING & RUBBER CO.
P. O. Box 1593, 345 Center Ave., N.W.
Roanoke 7, Virginia

RUBBER ENGINEERING & MFG. CO.
P. O. Box 2335, Salt Lake City 10, Utah

RUBBER MILLERS, INC.
707 S. Caton Ave., Baltimore, Md.

ST. LOUIS METALLIZING CO.
625 S. Sarah St., St. Louis 10, Mo.

L. H. SHINGLE CO.
1300 Walnut St., Camden 3, N.J.

STEBBINS ENGRG. & MFG. CO.
Watertown, New York

WILLOW RUN RUBBER COMPANY
12575 Haggerty St., Bellville, Mich.

Tailored to your specific needs, GAR-LINE* Penton** Linings can be applied to a variety of complex shapes as shown in these photos.

Investigate GAR-LINE Penton Tank Linings as the answer to your corrosion problems. For more information, contact the applicator nearest to you. Or, write for data on Penton; information also available on Teflon† linings for Anti-Stick or corrosive applications. Special Products Dept., Garlock Inc., P. O. Box 612, Camden 1, New Jersey.

*Garlock Registered Trademark
**Registered Trademark, Hercules Powder Company
†Registered Trademark, The DuPont Company

GARLOCK

neptune

An advertisement written to help you

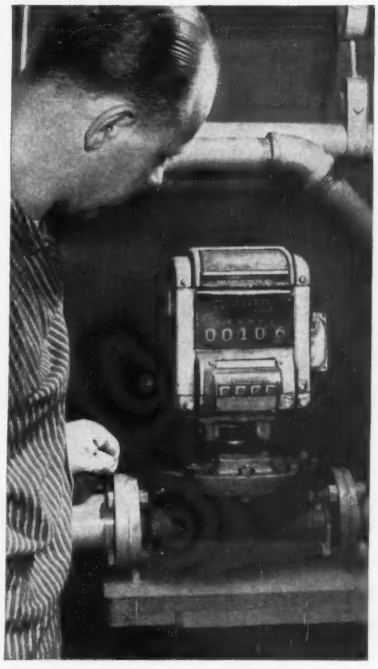
Measurement/Control News

prepared by Neptune Meter Company

West Chemical Improves Accuracy With Stainless Steel Batching Meters

Operator merely pushes buttons; Auto-Switch shuts off pump at exact quantity

LONG ISLAND CITY—For safety, speed and accuracy, West Chemical Products, Inc., reports excellent results after replacing gauge-stick measurement with stainless steel liquid meters in formulating CN-Plus, Westpine, Tamed Iodine and other West sanitation products.



"Big savings are time and materials," says Rudolph Londner, plant superintendent. It took time to stop the agitators, wait for liquids to stop swirling, open the lids, and read the gauge sticks. And when batching errors showed up in the quality control lab, *more* time was wasted making adjustments and retesting.

Now accuracy is controlled by push-button. A row of buttons on each meter sets the quantity. A switch starts the pump. The meter keeps count and stops the pump *automatically* at the anticipated quantity.

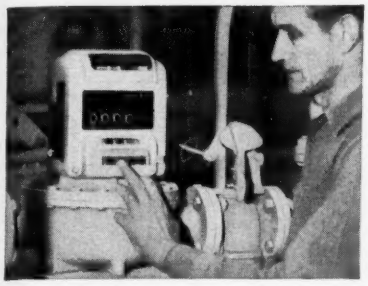
Plouronics-Iodine Complexes

For ingredients such as plouronics-iodine complexes, West uses Neptune stainless steel Auto-Switch meters, which have only two moving elements in contact with liquid. For non-corrosive liquids, bronze Auto-Switch meters are used.

By assuring closer control, meters help comply with labeling regulations, and assist in obtaining government contracts. West also uses Neptune meters in ion-exchange and chlorination processes, and in the manufacture of waxes and soaps.

How can you benefit from West Chemical's experience? Neptune field engineers will be happy to offer helpful suggestions. Phone or write today.

How St. Regis Gets Closer Control Over Clay & Starch Mixes

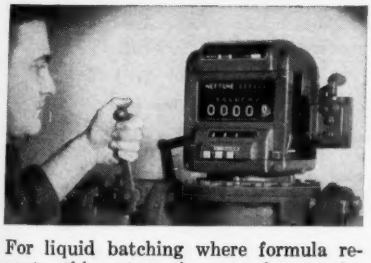


DEFERIET, N.Y.—In preparing both clay and starch mixes, the St. Regis fine paper mill here controls solution strength with automatic meters. In clay, meters are used at *three* stages: Adding water to dry clay to make 55% slurry; cutting slurry to 15%; and proportioning slurry and water at the beater to dilute to 2%.

In starch, meters measure water into cooker for 20% mix, then measure both hot starch and water for accurate dilution to 8%. Meters are Neptune Auto-Stop, 1 to 2 inches.

What works on starch and clay can also work for you. Write today.

Meter with a memory... Never forgets your formula

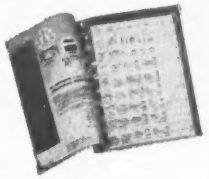


For liquid batching where formula repeats, this automatic meter has precise mechanical memory. Set quantity just once, open valve, and meter takes over. Shuts off at correct quantity batch after batch. Can even print tickets. Easy to reset for new formula. Ask for facts on Repeating Auto-Stop.

HOW TO STOP DRIP OF VISCOUS LIQUIDS. When metering viscous liquids, don't try to drain the line between meter and vat after each delivery. It'll drip forever, and you usually don't want air contact anyway. Instead, put an inexpensive spring-loaded Anti-Drip valve on the end of the pipe. Ask Neptune.

HELPFUL METERING DATA AVAILABLE

28-pg. technical bulletin lists liquids, helps pick proper sizes and features of meters 2 to 2000 gpm.



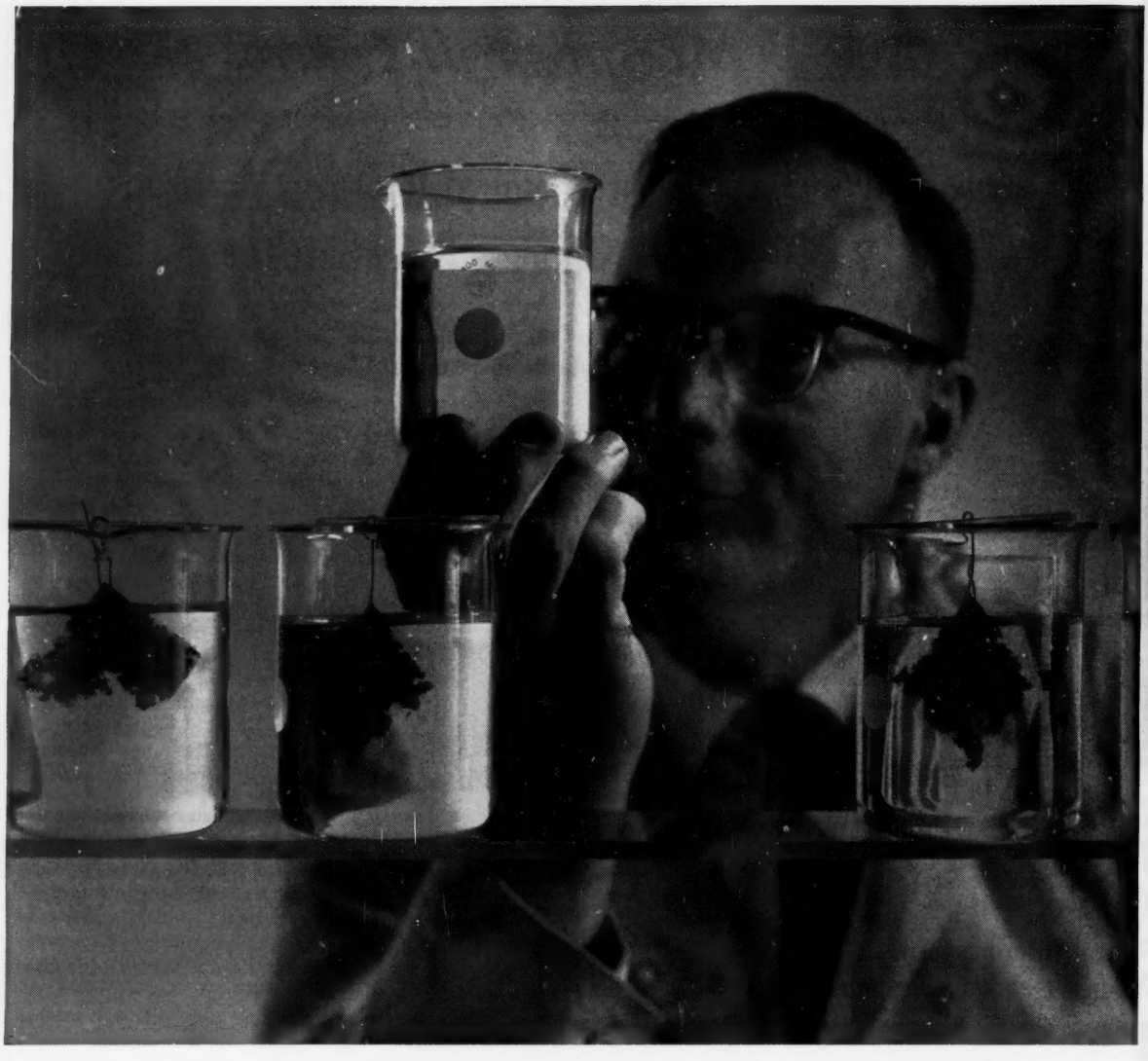
NEPTUNE METER COMPANY · Liquid Meter Division
47-25 34th St., Long Island City 1, N.Y.

Please send me helpful Meter Bulletin 566Q

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____



HOW TO RUN TWO SIMPLE TESTS ON PROCESS PIPE CORROSION

Test One

Take material samples of any corrosion-resisting pipe. Place them in beakers containing any acids, series of acids or combination of acids. Boil them, cool them or store them for any length of time you feel necessary.

Then compare the corrosion of the materials tested.

Next—look at the beakers you used! The chances are very good they are PYREX® brand beakers. And if they are, it should be evident that the beakers stand your test better than the materials tested.

You can have this same high corrosion resistance when you use PYREX® brand process pipe.

Test Two

The second test is more practical. Place one length of PYREX pipe in one of your most demanding process lines. It connects easily to other lines. Then compare it in actual use with the pipe you are using.

PYREX pipe is transparent. You can see through the pipe wall into the flow area. If you do have trouble with your process, you can locate it at a glance. No hit-or-miss dismantling. You nip minor problems before they become major. Hardly any maintenance or replacement costs to pick your pockets, either.

You can also get PYREX "double-tough" drainline for applications where you're handling corrosive wastes. Same tough glass. Same advantages.

PYREX pipe comes in all standard sizes and fittings. Want more specifics? Write for PYREX Pipe Bulletin, PE-3.

CORNING GLASS WORKS
8908 Crystal Street, Corning, New York
CORNING MEANS RESEARCH IN GLASS

2 Michigans, special equipment, reduce operating costs for Cargill, Inc.

Simply taking advantage of a manufacturer's optional equipment has enabled Cargill, Inc. to adapt two Michigan Tractor Shovels to material handling jobs that otherwise would require larger, more expensive machines.

Required—compact machine with extra high dump

At Cargill's Omaha, Nebr. warehousing subsidiary, Cargo Carrier Inc, material handling is almost fully automatic —conveyors carry bulk fertilizer and rock salt from hoppers to bin, bag and box car. But in two important areas, material handling is assigned to Tractor Shovels—transporting materials from bins to hopper...and truck-loading out of bins: Both jobs pose special problems.

For example, bulk truck-loading requires a machine that can maneuver in cramped bins, around close-spaced support posts, through a low clearance door . . . and still dump into huge transport trucks. A compact 77 hp Michigan Model 75A proved perfect for bin operations, and its 1¼ yd bucket provided the required capacity. But dumping height (9′7″) was insufficient to clear the 10′2″ high sides of 20 ton trucks. The solution: optional high-lift arms which gave 2′2″ more clearance than the rig's standard arms.

Required—small machine with extra big capacity

The other assignment—moving fertilizer from bins to hopper—calls for a much more compact Tractor Shovel . . . one that can maneuver through aisles and bin openings *only 6 ft wide and 6 ft high.* Here the Model 12B (smallest of the nine-model Michigan line) proved the perfect size. But its standard 16 cu ft bucket was too small to transport enough fertilizer to meet Cargill's production needs. One obvious solution, add another machine, was not practical due to cramped quarters and added costs.

The answer: fit the 44 hp Model 12B *with a one yard bucket* (one of six bucket options on this machine). After all, fertilizer is relatively light weight—about 60 lbs/cu ft—a yard would weigh well under the Michigan's 2900 lb capacity. Nor would the extra 12″ bucket width (62″ total) pose any maneuverability problem.

Production high . . . availability excellent

Cargill reports complete success in both applications! The Model 75A loads 20 ton trucks in less than 10 minutes, 14 passes, 100 ft one-way trips bin to truck. The Model 12B feeds hoppers for both bagging and railway box car loading, often works 24 hours a day, handling granulated fertilizer.

"We consider high output plus excellent availability Michigan's biggest benefits," summarizes Plant Supt Merle Bruce. "A fertilizer plant like ours offers difficult working conditions for the Michigans—dust, cramped quarters, round-the-clock duty—but in two years neither Michigan has given us a bit of trouble . . . or held up production."

Michigan is a registered trademark of

CLARK EQUIPMENT COMPANY
Construction Machinery Division

CLARK® EQUIPMENT

2477 Pipestone Road
Benton Harbor 44, Michigan

In Canada:
Canadian Clark, Ltd.
St. Thomas, Ontario

WAGNER®
MOTORS
AT
WORK

power to move petroleum to market

Cool-running Wagner® 500 hp tube ventilated motor provides explosion-proof drive for pumping crude oil from storage to tankers at sea.

Logistically complex job, moving petroleum products to market. Demands skill and know-how. Demands plenty of power, too . . . power provided, in many instances, by Wagner Tube Ventilated Motors.

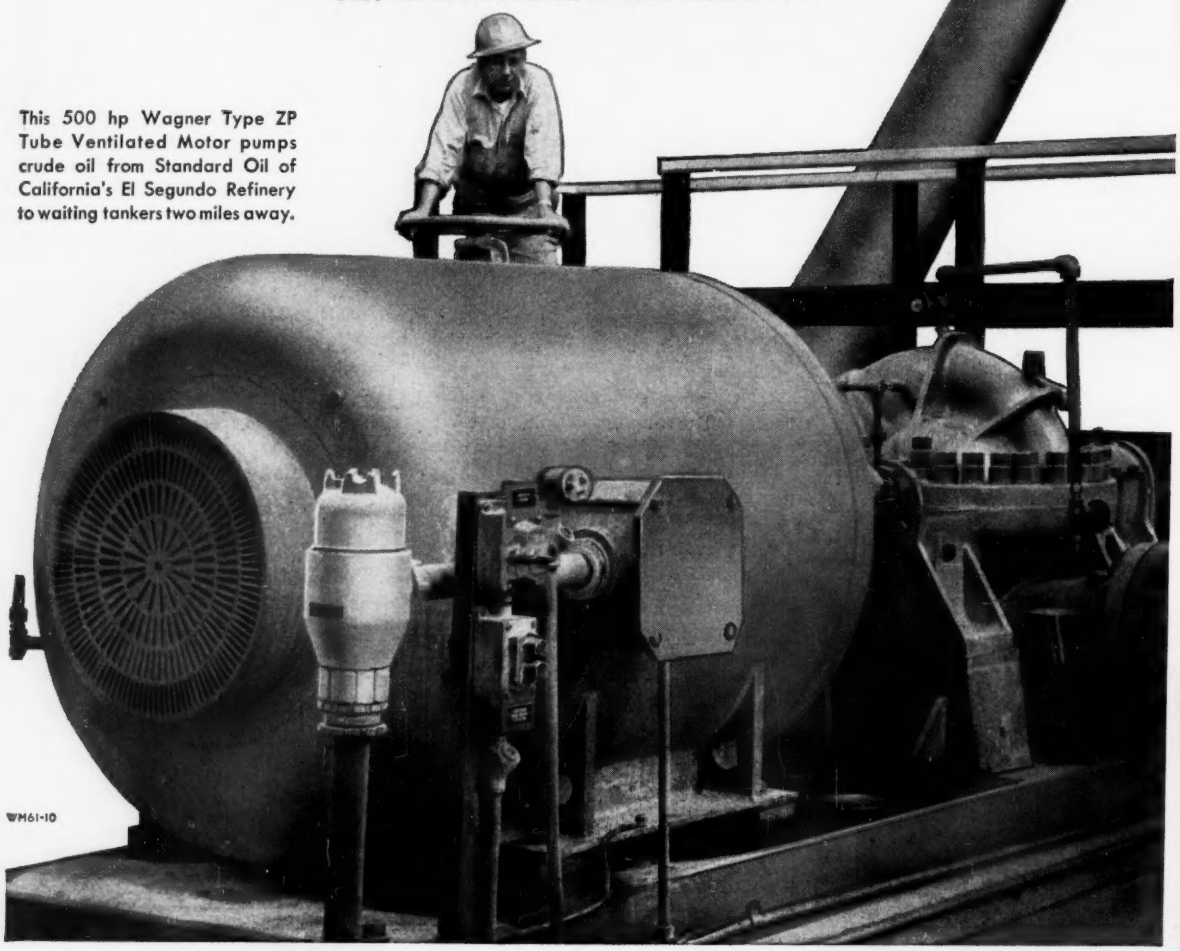
But powering the pumps that start petroleum products on their way to the corner service station is just one of many jobs performed by these stamina-packed motors. They are also used as drives for big fans, blowers, compressors . . . any heavy-duty application. Built in ratings through 500 horsepower, these totally-enclosed, fan-cooled motors are tube ventilated for cooler running, longer life. Type YP, standard TEFC, or Type ZP, explosion-proof, can be supplied with Underwriters' Label for hazardous locations.

When you need motors that can operate for long periods of time without maintenance . . . that keep right on producing the power you need even under the most critical conditions, choose from these Wagner® Big Job-Rated Motors. Check with your Wagner Sales Engineer; he'll show you how they'll solve your large motor problems.

Branches and Distributors in all Principal Cities

Wagner Electric Corporation

6407 PLYMOUTH AVENUE, ST. LOUIS 33, MO., U.S.A.



This 500 hp Wagner Type ZP Tube Ventilated Motor pumps crude oil from Standard Oil of California's El Segundo Refinery to waiting tankers two miles away.

WM61-10

BULLETIN:

New Shell pocket computer helps calculate the evaporation rate of a hydrocarbon solvent in minutes—can be used right at your desk

Shell has invented a handy six-inch computer that lets you calculate solvent evaporation rates at your desk. It's called the Evapo-Rater.*

Here's how it can save you time and help avoid costly trial and error experimentation.

FOR THE first time you can determine solvent evaporation rates without leaving your office.

Shell's new Evapo-Rater does the work for you.

Supplements laboratory device

For years manufacturers have been familiar with the Shell Thin Film Evaporometer—used to determine evaporation rates.

But the Evaporometer resides in laboratories. It is expensive and time-consuming to operate. And it stands about 3 feet high.

So now Shell has invented the new six-inch Evapo-Rater, shown above.

Gives answer in minutes

The new Shell Evapo-Rater is based upon hydrocarbon evaporation rates determined by the Thin Film Evaporometer. It approximates results you can obtain with an Evaporometer, and gives you an answer in a matter of minutes.

The Shell Evapo-Rater makes selection of the correct hydrocarbon solvent quicker and easier than ever. It reduces the need for extensive trial and error experimentation.

New Shell Evapo-Rater, above, determines solvent evaporation rates in minutes. Shell is offering the Evapo-Rater to help users select the correct hydrocarbon solvent.

Works for blends of solvents

And it permits you to determine the evaporation rates for *blends* of hydrocarbon solvents as well. All this can save you valuable time and money.

A limited supply of Evapo-Raters is available for solvent consumers and can be obtained from your local Shell Oil representative. Call him today.

For address of nearest Shell representative, write Shell Oil Co., 50 West 50th Street, New York, N.Y.

SHELL

A BULLETIN FROM SHELL
—where 1997 scientists are working to provide better products for industry

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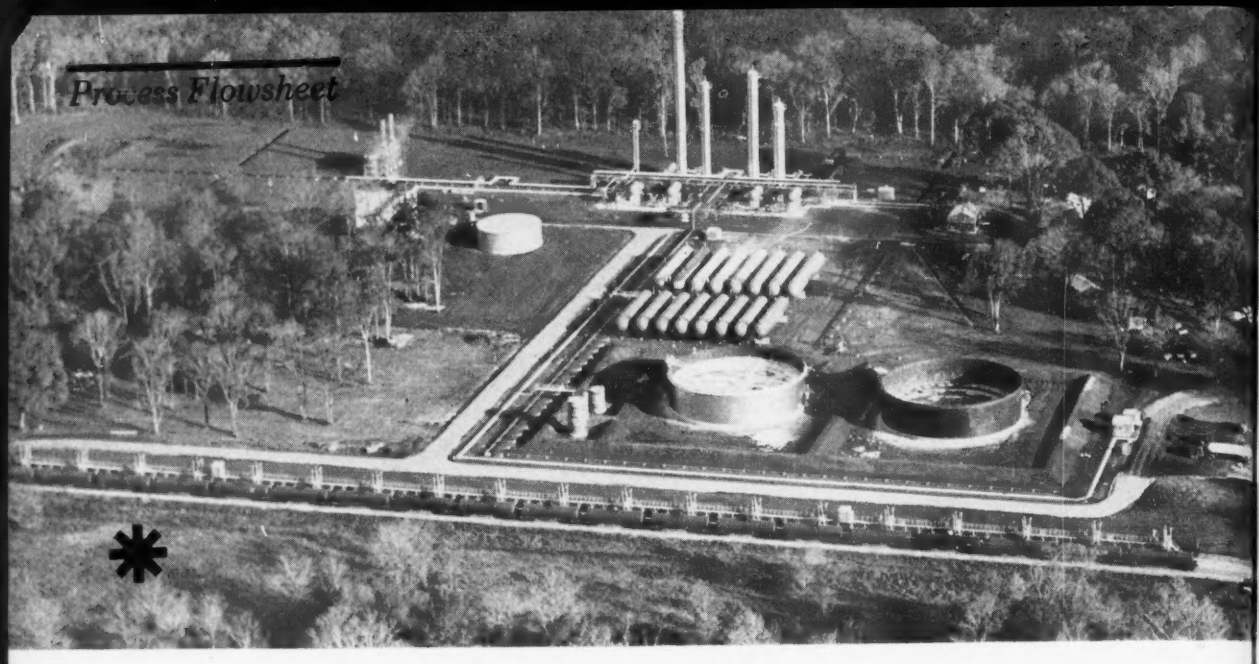
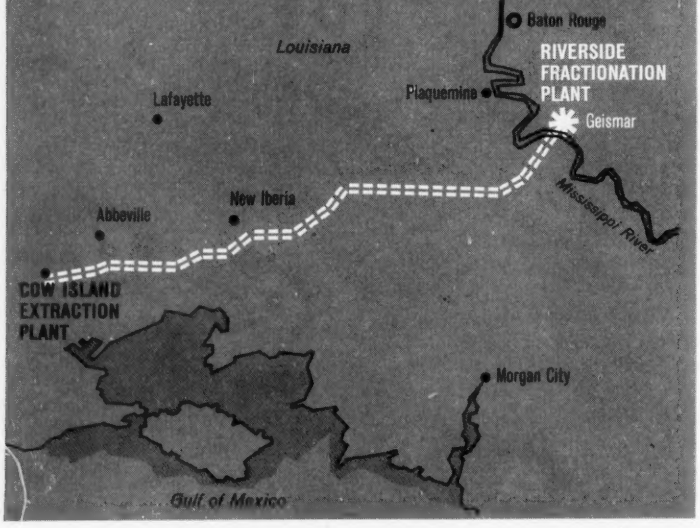
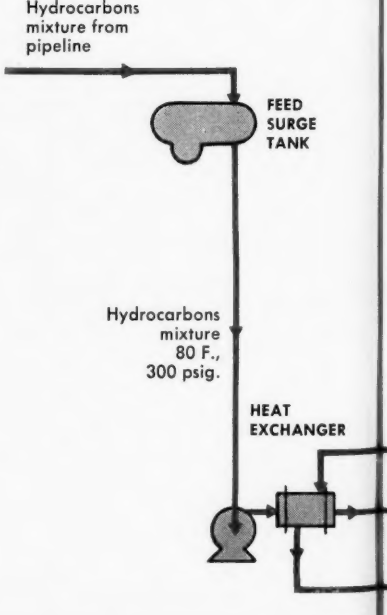


Payoff Plant for Lean-Gas Venture

Here's the wrap-up of Union Oil Co. of California's and Goliad Corp.'s joint assault on the chemical content of lean natural gas: an 86-mile pipeline conveys mixed hydrocarbons to a market-oriented fractionation plant.

T. H. ARNOLD, JR.
Southwestern Editor





Unfold flowsheet

One key concept lies behind the joint success of Union Oil Co. of California and Goliad Corp. in winning petrochemical feedstocks from lean Louisiana natural gas: smart, if unorthodox, placement of processing facilities.

Usually, a natural-gas liquids operation both extracts and fractionates its raw-liquids mixture at one site. But Union and Goliad built their extraction plant near the gas source, their fractionation unit near the product market—former is a 450-million-cu. ft./day facility at Cow Island, Vermilion Parish, La., and the latter a 10,000-bbl./day plant at Geismar, La. Linking them is an 86-mile pipeline to transport raw extract mixture.

Our previous Process Flowsheet (*Chem. Eng.*, July 24, p. 118) covered the extraction plant; the present article highlights the pipeline and the fractionation facility.

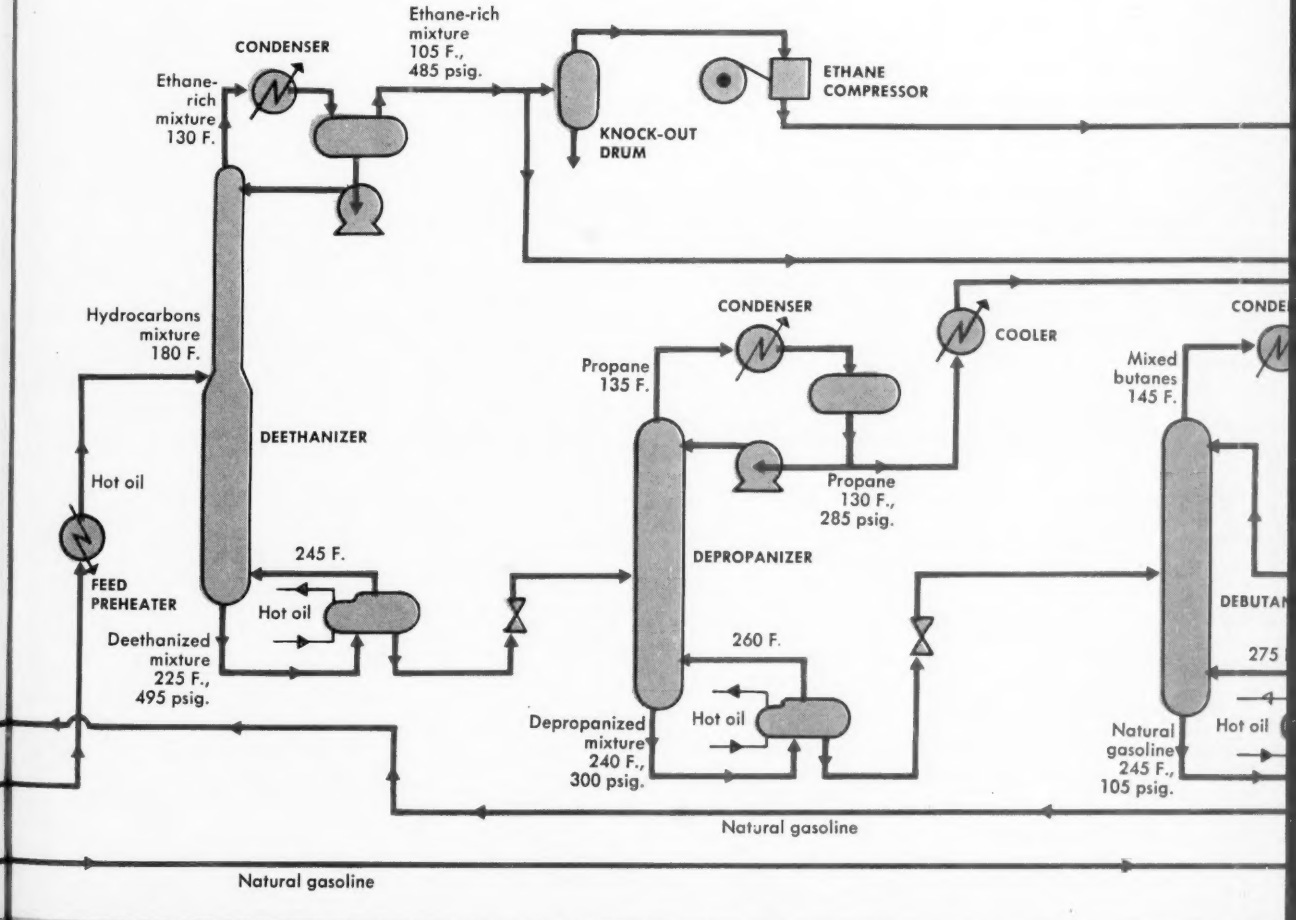
▶ **Pipeline Feat**—Between Cow Island and Geismar lies Louisiana's Atchafalaya flood basin, a vast, wooded swamp that railroad and highway planners have always carefully skirted.

Thus, installing the pipeline was a feat in itself. Sibon Pipeline Co., a Goliad subsidiary, supervised over-all construction and is operator of the system. The crucial Atchafalaya section was installed by Brown & Root, Inc., Houston.

To accomplish the trick, Brown & Root dredged a flotation canal, then laid pipe from a barge into a smaller ditch cut into the bottom of the canal. This section of the line was coated with concrete, as was the Mississippi River crossing near Geismar.

Both end-sections consist of 6-in. pipe, but the portion that spans the basin proper is 8 in. in dia.—to avoid need for negotiating the swamp again if the extraction plant expands output. A single pump station at Cow Island meets present energy requirements, and provision has been made for two more stations if needed.

▶ **At Geismar**—The fractionation plant is designed for easy expansion to 30,000 bbl./day. Raw mixture from Cow Island currently amounts to only 7,000 bbl./day, but Goliad is bullish about the area



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between Baton Rouge and New Orleans as a coming petrochemicals complex, is betting on a big increase in market for its products.

Output at Geismar is roughly 3,000 bbl./day propane and 1,000 bbl./day each of natural gasoline (#12 Reid vapor pressure), normal and isobutane, and an ethane-propane mixture that goes directly to Dow Chemical Co's. nearby ethylene unit at Plaquemine, La.

The mixture from Cow Island enters a feed surge tank, where it is held at 80 F., 300 psig. Stream is heated to 180 F., then enters a deethanizer. Ethane-rich overhead product, at 105 F. and 485 psig., splits into two streams: one is compressed and pipelined to Dow, the other enters a fuel-gas fractionator.

This unit has an internal reflux condenser that is fed with 42 F. water. Fractionation yields 60 F. ethane overhead, which goes to plant fuel, and propane at 180 F. and 480 psig. Latter cools by heat exchange with the ethane, then is routed to storage.

▶Split the Mixture—Meanwh
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for separation into its cons
place in three successive tow

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Depropanized mixture l
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Mixed butanes pass over
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product is 135 F. isobutane;
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A 46.8-million-Btu./hr. di
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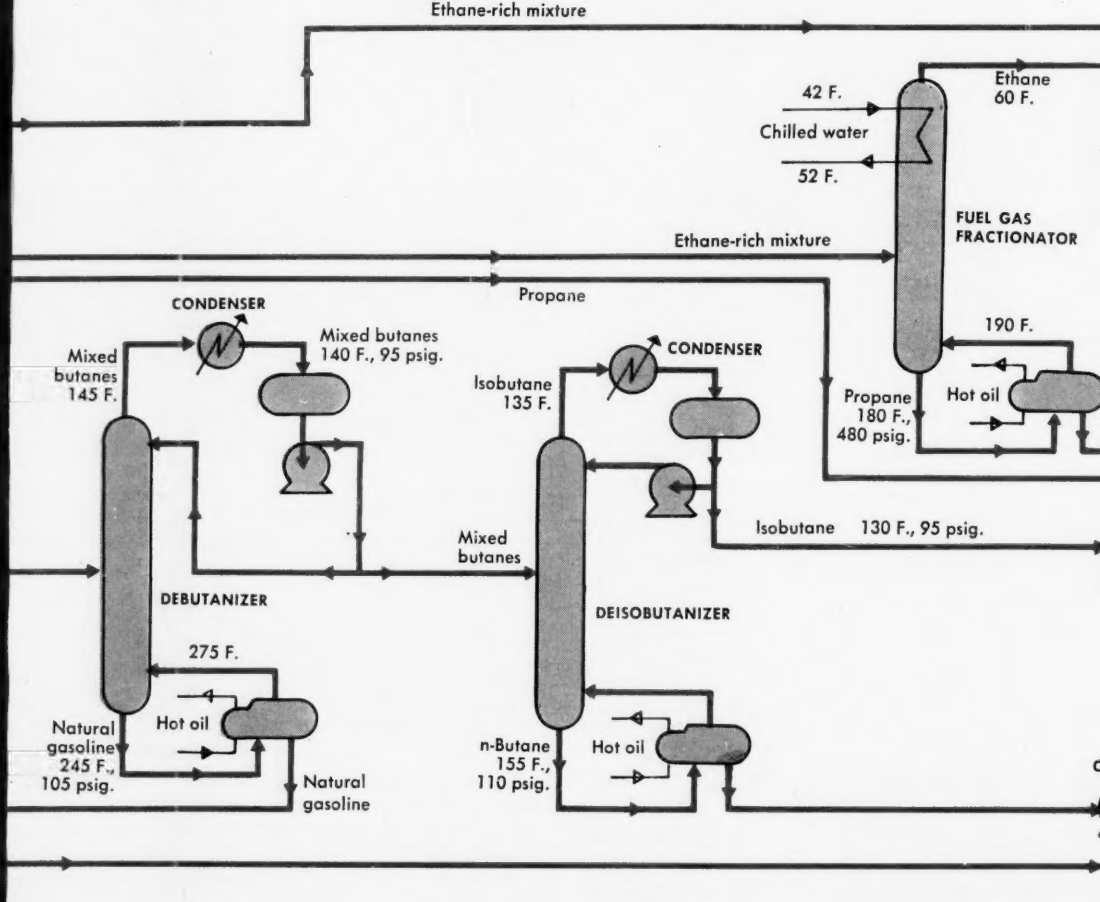

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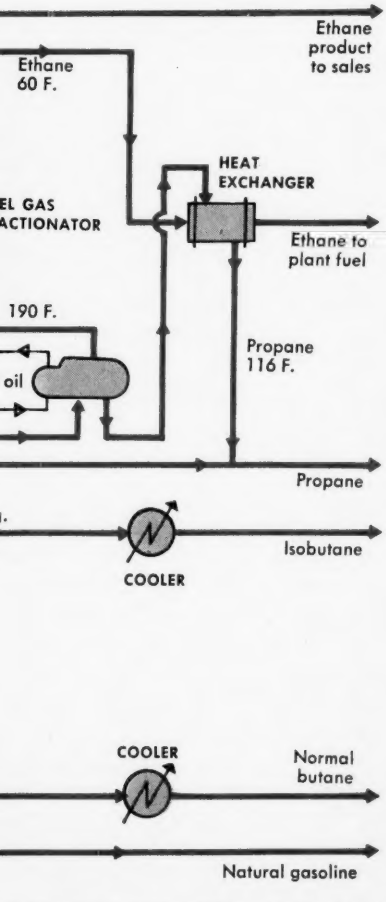

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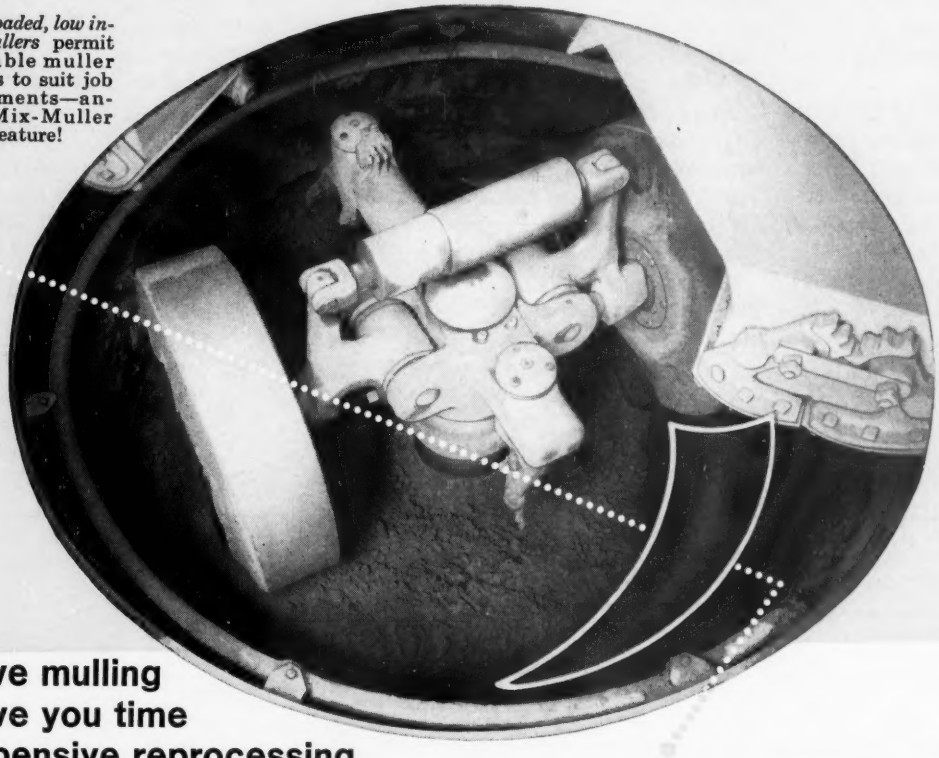
See our ad

CHEMICA

MIX-MULLER®

MEANS CONTROLLED DISPERSION FOR DRY SOLIDS:

Spring loaded, low inertia mullers permit adjustable muller pressures to suit job requirements—another Mix-Muller control feature!



P360

Intensive mulling can save you time and expensive reprocessing

The Simpson Mix-Muller is specifically designed to put *you* in control of mixed properties. In this era of expensive, high purity materials such a machine can, in one operation, help you eliminate reprocessing, remixing and slash waste and rejects simply by making the *most* of prepared ingredients.

For these reasons, the rapid increase in the use of the Simpson Mix-Muller has paralleled the increasing availability of better, more uniform and more *expensive* raw materials.

For similar reasons . . . Mix-Muller usage has paralleled a new, enlightened attitude on mixing practice among processors who have learned that careful attention to mixing operations can be their most important source for *savings*.

Can you *afford* to settle for less than controlled dispersion?

See our advertisement: CHEMICAL ENGINEERING CATALOG

SIMPSON MIX-MULLER® DIVISION

National Engineering Company

636 Machinery Hall Bldg. • Chicago, Illinois

3 way mulling action coats each grain

. . . KNEADING

Because the mullers never touch the wearplate, you get an intensive kneading of the muller against material grains—through a deep bed of material.

. . . SMEARING

The inside edges of the wheel have a shorter distance to travel than the outside edges to provide a smearing action—across the wide face of the mullers.

SPATULATE ACTION

...Note that mullers are set slightly off true radius so that as they roll they also skid sidewards to provide a spatulate action.

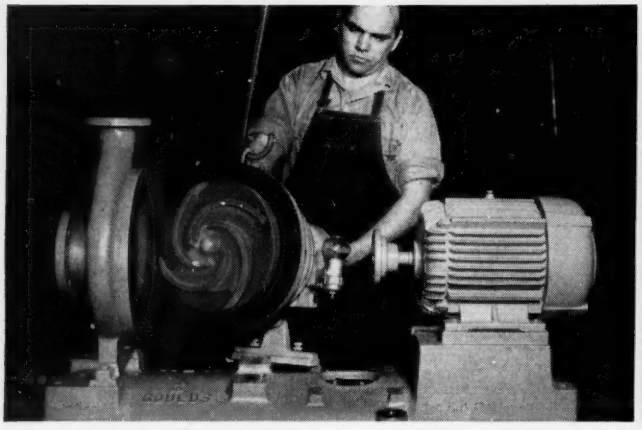
. . . THIS IS CONTROLLED DISPERSION

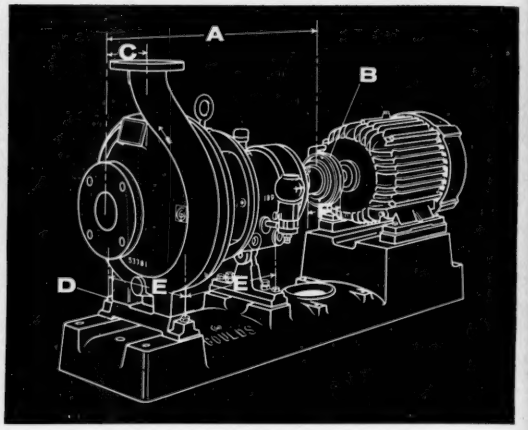
WRITE FOR HANDBOOK

—on mulling. 12-page bulletin explains controlled dispersion—gives details on 9 Mix-Muller models (¾ to 60 cu. ft. batch capacity).

PUMPAGE

Goulds news about pumps for process industries





Standardized design features

Model 3195 gives you the greatest range of coverage and flexibility—with minimum parts needed—of any design on the market.

To meet varying service conditions, you can mount any one of the 11 pump ends to any one of three bearing frames (shafts 1¼, 1¾, and 2⅛ through stuffing box). Nominal impeller diameters of 6″, 8″, and 11″ cover the range. Capacities to 775 G.P.H., heads to 300 ft. TDH. Handles liquids up to 500°F.

Dimensional interchangeability between all Model 3195 pumps

With this top-centerline, broad-coverage design, you can interchange pumps without making expensive piping changes. It has

A	One over-all length in all sizes	23″
B	One coupling fit for all sizes	1⅛″
C	One dimension end from suction to centerline of discharge	4″
D	One bolt size for holding pumps to bases	½″
E	One bolt spacing for holding all pumps to bases	
F	One spacer coupling length for all sizes	3½″

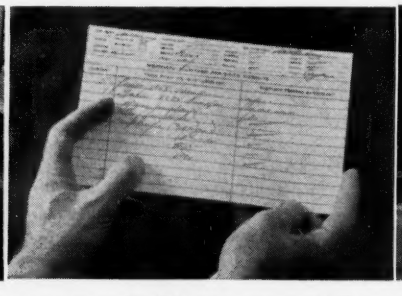
Back pull-out design lets you easily replace parts most subject to wear without disturbing pipe connections or motor mountings. For full information, write for Bulletin 725.1.

How to dewater a flood

Deep in a Virginia mine, water that could fast become a flood is being pumped out at as much as 8000 gpm for New Jersey Zinc Company.

More than a generation of miners has grown up since the first of the pumps started working. Yet these pumps, as well as the newer ones, perform so dependably that four more are slated to join them.

All 30 are Goulds single-stage, double-suction centrifugals. All use mechanical seals. All are grease lubricated.

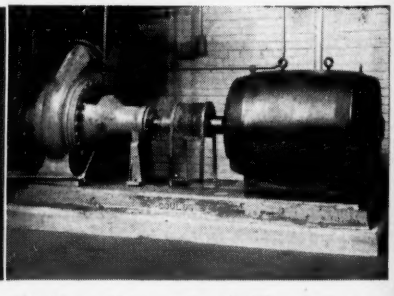


Easy way to diagnose pump failure

Keep complete maintenance records on easy-to-use cards. Failures show chronologically, making it easier to get at the root of the trouble.

Cards are a help in ordering new parts, scheduling lubrication, and in determining pump suitability for new requirements due to process change.

Like a free supply of these pump maintenance record cards? Drop us a line. For information on this, or other products on this page, write Goulds Pumps, Inc., Dept. CE-81, Seneca Falls, N.Y.



Unique-alloy pump fights abrasives

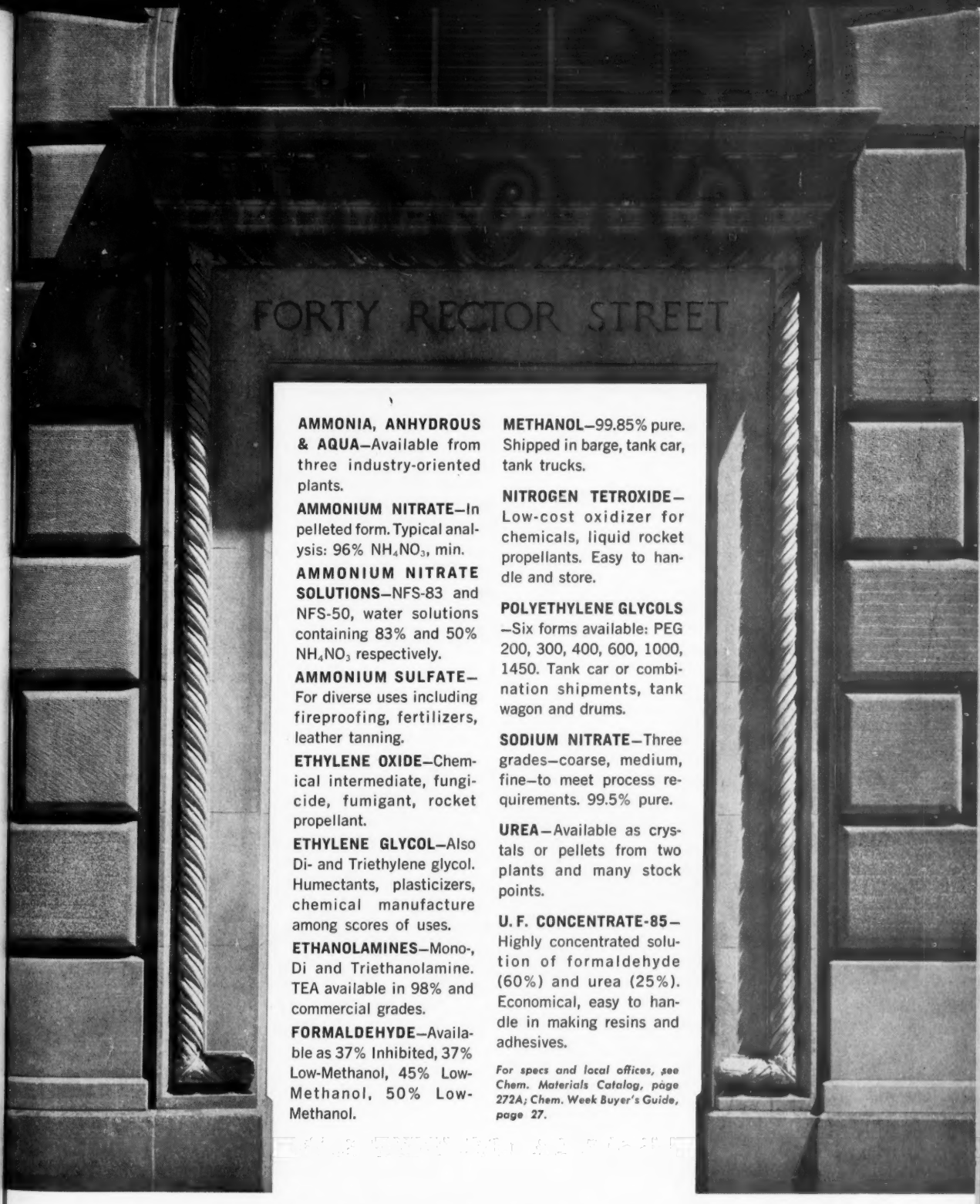
The first pump in the system at Bestwall Gypsum Company's Pryor Mill works on a particularly tough service. It must handle bits of metal and glass the junk remover doesn't get.

It's a Goulds Model 3139 constructed of ISO-40.* This stainless steel alloy, highly resistant to corrosion and abrasion, has BHN hardness of 320 and tensile strength of 140,000 psi.

Do you have a similar severe application problem? Let us know. ISO-40 is available in several of our designs.

*Registered trademark of Empire Steel Castings, Inc.

GOULDS PUMPS



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AMMONIUM SULFATE—For diverse uses including fireproofing, fertilizers, leather tanning.

ETHYLENE OXIDE—Chemical intermediate, fungicide, fumigant, rocket propellant.

ETHYLENE GLYCOL—Also Di- and Triethylene glycol. Humectants, plasticizers, chemical manufacture among scores of uses.

ETHANOLAMINES—Mono-, Di and Triethanolamine. TEA available in 98% and commercial grades.

FORMALDEHYDE—Available as 37% Inhibited, 37% Low-Methanol, 45% Low-Methanol, 50% Low-Methanol.

METHANOL—99.85% pure. Shipped in barge, tank car, tank trucks.

NITROGEN TETROXIDE—Low-cost oxidizer for chemicals, liquid rocket propellants. Easy to handle and store.

POLYETHYLENE GLYCOLS—Six forms available: PEG 200, 300, 400, 600, 1000, 1450. Tank car or combination shipments, tank wagon and drums.

SODIUM NITRATE—Three grades—coarse, medium, fine—to meet process requirements. 99.5% pure.

UREA—Available as crystals or pellets from two plants and many stock points.

U. F. CONCENTRATE-85—Highly concentrated solution of formaldehyde (60%) and urea (25%). Economical, easy to handle in making resins and adhesives.

For specs and local offices, see Chem. Materials Catalog, page 272A; Chem. Week Buyer's Guide, page 27.

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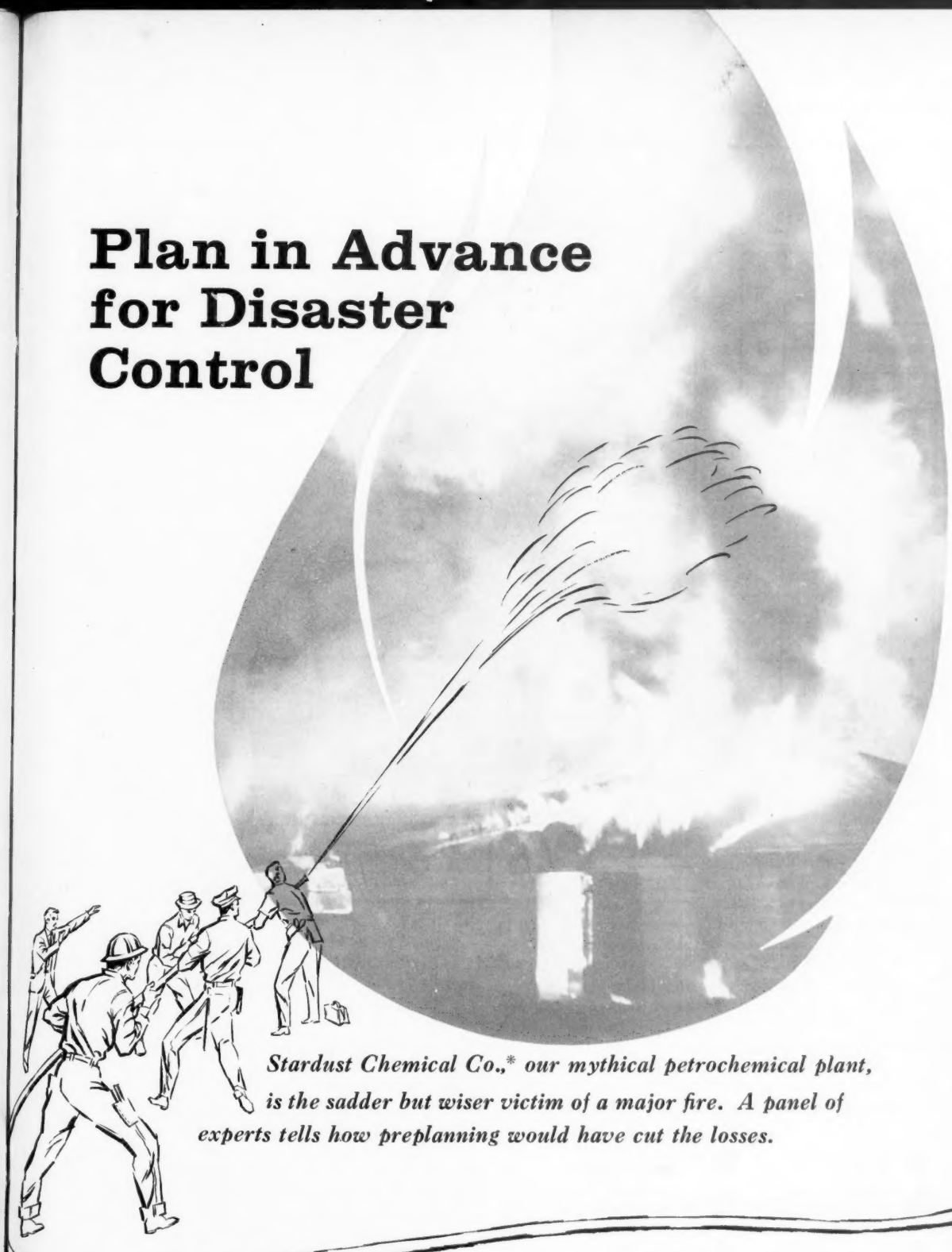
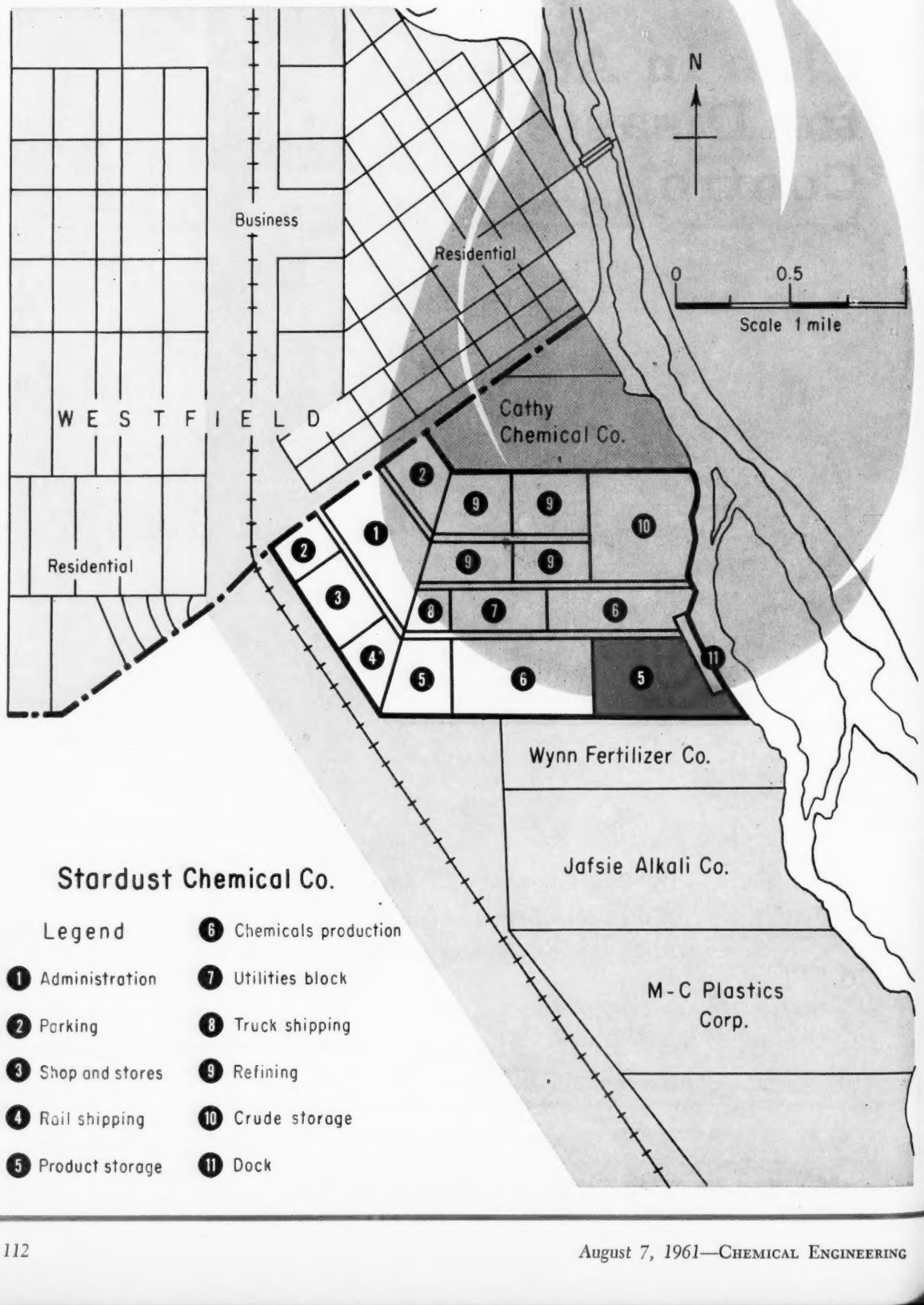
Plan in Advance for Disaster Control



Stardust Chemical Co.,* our mythical petrochemical plant, is the sadder but wiser victim of a major fire. A panel of experts tells how preplanning would have cut the losses.

* Stardust Chemical Co. originated with the Industrial Section of the Texas Water and Sewage Works Assn.'s Short School, which is held annually at Texas A & M College, College Station, Tex. Stardust proved to be such a good whipping boy for discussing controversial topics that *Chemical Engineering* recorded and published the three resulting meetings.

Peter Brennan, former *CE* assistant editor, thought of inflicting a disaster on Stardust and holding a panel discussion on the results. He arranged with the National Institute for Disaster Mobilization to hold the panel during that organization's fifth annual seminar in Houston, Tex., this past April. When Peter left the magazine to join General Atomic in La Jolla, Calif., Jim Marshall, another assistant editor, took over the job. Jim wrote the problem and formed the panel.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Business
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Cathy Chemical Co.
Wynn Fertilizer Co.
Jafsie Alkali Co.
M-C Plastics Corp.
Stardust Chemical Co.
Legend
1 Administration
2 Parking
3 Shop and stores
4 Rail shipping
5 Product storage
6 Chemicals production
7 Utilities block
8 Truck shipping
9 Refining
10 Crude storage
11 Dock

Turn the page for the experts' comments.....

How Stardust Let a Small Fire Become a Major Disaster

Stardust Is a Petrochemical Complex

Stardust Chemical Co.'s plant on the outskirts of Westfield has two principal divisions—a petroleum division that manufactures gasoline and associated products; a chemicals division that produces petrochemicals from byproduct gases of the refinery, and raw materials from distant gas fields. The plant is located on a tidal estuary in the Gulf coastal area.

Major Products and Capacities

Acetaldehyde	100,000 lb./day
Acetic anhydride	75,000 lb./day
Ethanol	50,000 gal./day
Ethyl chloride	25,000 lb./day
Ethylene glycol	30,000 gal./day
Formaldehyde	20,000 lb./day
Methanol	45,000 gal./day
Triethanolamine	10,000 lb./day

Employees

Total employees at the plant number 2,300, of which 800 are employed in the petroleum division and 1,500 in the chemicals division.

Stardust's Industrial Neighbors

Jafsie Alkali Co.—produces sodium hydroxide, chlorine and hydrochloric acid—410 employees.

Cathy Chemical Co.—produces fine chemicals and catalysts, both organic and inorganic—100 employees.

Wynn Fertilizer Corp.—produces phosphate fertilizers and other agricultural chemicals—210 employees.

M-C Plastics Corp.—produces chlorinated paraffins, phenol-formaldehyde resins, modified acrylonitrile polymers and associated plastics—625 employees.

The city of Westfield has a population of 25,000 people.

How the Disaster Took Place

The fire started in a pumphouse in the product storage area adjacent to the dock. Source of fuel was a leaking pump gland, but the source of ignition is unknown.

A shipping operator noticed the fire and attempted to fight it with the CO_2 extinguishers available in the pumphouse. After several minutes, however, he realized that the fire was beyond his control and ran to turn in the alarm in the nearby chemical unit.

Shortly thereafter, heat caused the rupture of a line in the pumphouse and the fire was fed anew from a methanol tank that was connected to the line. An explosion occurred and ruptured this tank.

When the shift fire squad arrived, a strong breeze from the river was spreading the flames to the nearby chemical production and utilities blocks. Wooden scaffolding, tarpaulins and other construction debris had ignited in the chemical block.

On the road passing by the plant's main gate, several motorists had noticed the smoke and flames and stopped to watch. Some of these motorists continued into Westfield, where they spread the news.

Meanwhile, in the plant, heat had weakened the unprotected legs of a rundown tank in the chemical block—the legs buckled, another line ruptured and the tank exploded. A grass fire in the utilities block was threatening to isolate the water pumphouse.

At this point, the fire squad realized that it needed outside help and put its request to the plant manager. There was some delay in reaching the Westfield Police and Fire Departments and the neighboring plants, because the Stardust switchboard was jammed with incoming calls inquiring about the fire. All were eventually contacted, however, and promised to send help.

Reporters from the local newspaper and radio station arrived at the plant gate to investigate the rumors being spread in the town. No one from plant management was available to talk to them, however, and the guards gave them short shrift. Finally, they talked to two injured workers who had been brought to the gate and got their stories. As a result, confused and exaggerated accounts were broadcast, and the roads and switchboard became all the more jammed by relatives of employees and also curiosity seekers.

The police arrived to set up roadblocks around the area but found that the roads were already nearly blocked by sightseers. This congestion considerably delayed the arrival of the municipal and industrial fire squads, as well as a city ambulance.

When the outside fire forces finally succeeded in reaching Stardust, there was further delay within the plant because the outsiders were unfamiliar with the plant layout, and the plant roads were congested with employees watching the disaster. More confusion arose at the scene of the fire because no one had been designated to take over-all control of the fire fighting. After augmenting the water supply by pumping from the river and municipal mains, the crews after several hours brought the fire under control.

Property damage has been estimated to be in excess of $1,000,000. Several men were injured—some with permanent disabilities. It is difficult to assess the losses in sales and permanent business that will result from the period that the chemical producing units will be shut down. No alternate sources of product are available for Stardust to supply its customers and many of the damaged pieces of equipment are long-delivery items.

STARDUST CHEMICAL CO., our imaginary oil refining and petrochemical operation on the Texas Gulf Coast, has once again demonstrated its penchant for trouble. This time, Stardust finds itself the victim of a major fire—a fire whose effects were greatly magnified by a lack of preplanning for disaster control.

On three previous occasions, the company has successfully presented its problems for solution to panels made up of technical personnel, governmental authorities and the public. The first of these problems (*Chem. Eng.*, Dec. 1957, pp. 237-252) was a water shortage. In the second case (*Chem. Eng.*, July 14, 1958, pp. 129-140), plant effluents were polluting the nearby river and bay, and in the third case, Stardust had air-pollution woes (*Chem. Eng.*, Aug. 10, 1959, pp. 113-124).

This year, the panel was a feature of the Fifth Annual Industrial Mutual Aid & Disaster Control Seminar, held in Houston during April and sponsored by the National Institute for Disaster Mobilization and the Channel Industries Mutual Aid Assn.

The problem, (see the previous page), was prepared by *Chemical Engineering* and presented to the panel of safety and disaster-control authorities. As you can see, Stardust was not prepared to handle a major fire, either from the standpoint of its in-plant program or its arrangements with the neighboring industries and community.

Moderator of the panel was Alan L. Kling, director of loss prevention for Olin Mathieson Chemical Corp., who also played the role of Stardust's plant manager. He introduced the problem, which was then discussed by the panel and the audience.

Henry E. Webb (Monsanto Chemical Co.) acted as Stardust's safety director and outlined his plans for improving the in-plant safety program. C. L. Gilmore (Monsanto Chemical Co.), who represented M-C Plastics Corp., one of Stardust's neighbors, told how a mutual aid organization could be set up in the area. Chief Dallas W. Bias (Charleston, W. Va.) took the part of chief of police for the city of Westfield and told how municipal, county and state law enforcement bodies can cooperate with industry.

Robert R. Velie (Chesapeake & Potomac Telephone Co. of West Virginia), representing the Westfield County Telephone Co., described plans for a disaster-control communications system and also told how public relations could have been better managed during the disaster. Finally, James E. Fauber (Pittsburgh Plate Glass Co.), speaking for Stardust's corporate management, summed up the lessons to be learned from the incident and outlined the company's plans for reform.

ALAN L. KLING: If you will refer to the background data and to the map, I will briefly outline the problem.

Down in Area 5, next to the loading docks, a pump began to leak—a common occurrence. A fire started at that point and got out of control because the plant was not in the proper shape to handle it. From then on, everything happened that could possibly happen in a disaster.

The panel members are going to take certain phases of this disaster and analyze it, evaluate what happened, and come up with what they think are reasonable solutions to the difficulties that Stardust encountered.

Let me introduce, first of all, the man you might think has the responsibility for safety at Stardust—the safety director. He does not have this responsibility, however, because I am the plant manager. This is my responsibility and I cannot pass over it or give it to anyone else. Nor can I give away the responsibility for production, quality, disaster planning or anything else.

I can assign these things and give backing and support, but the final responsibility is mine. The most the safety man or anyone else working for me can do is to carry out his assignments. This is a very important point for every plant manager to keep in mind.

Another point I want to make is that this problem is not something that happens only to a chemical plant or to the chemical industry. This disaster could happen to any plant in any industry, and whether you're a member of that industry or not makes very little difference—you're still affected as a private citizen. As private citizens, we should all be concerned that the industries and activities in our town are well organized because they affect us in many ways.

Now, our safety director, Henry Webb, will tell us what should have been done and what has been done for Stardust's in-plant program.

Safety Director Proposes New In-Plant Program

HENRY E. WEBB: In a situation such as this, there are always several points where, if someone had done otherwise, he would have averted a disaster or emergency.

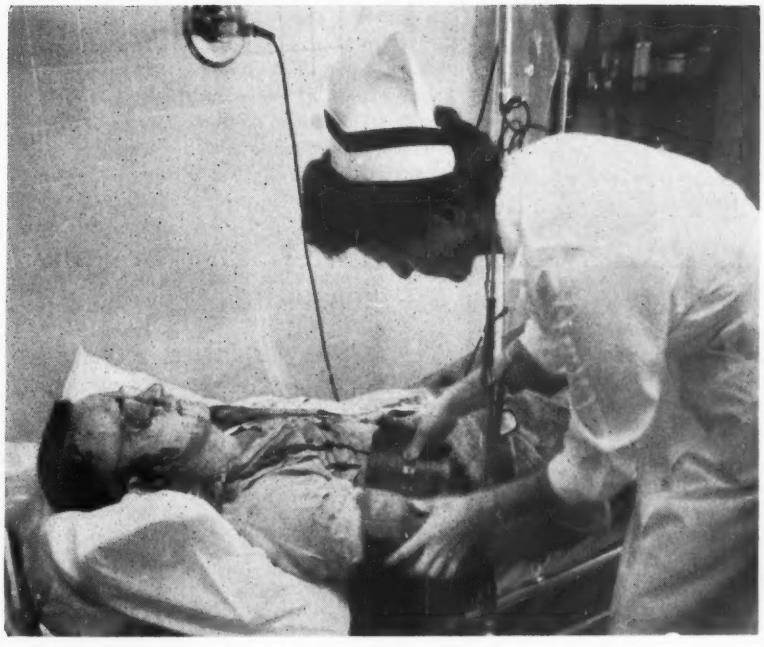
A critical review of the disaster and the elements contributing to its development can be summarized as follows:

1. There was a delay in turning in the alarm. This delay contributed to the magnitude of the emergency because there was no automatic fire-protection equipment to check flame propagation.

2. The fire spread was aided by the wind, by inadequate protection for our tankage and by poor housekeeping.

3. Fire fighting at the origin of the fire was poor. No one assumed over-all control of the action to contain and extinguish the fire. The shift fire fighters were almost cut off from their water supply, and there was considerable delay in requesting outside help. The scope of the emergency was not recognized.

4. In our zeal for production, we forgot to engineer for safety! We forgot to establish and test departmental plans and to expand these plans to include the entire plant. We haven't had dry runs in our plant nor have we worked with our neighbors to develop a mutual-aid organization.



On-the-job safety training should include first-aid instruction. Leadership must come from top plant management for best effects.

I believe that we can prevent a recurrence of this disaster with a threefold attack aimed at process safety, personnel training and property protection.

I place process safety first because, with the aid of the safety audit I will outline, we immediately integrate safety of design, operator training and operations. A process-safety audit must be executed before we restart any of our units and it must be repeated at least semiannually, or if we change operating conditions or relocate an operation.

The questions listed in the unit process-safety audit are to be applied to every process with the idea of revealing unsafe practices that were not previously recognized. If these questions uncover conditions that constitute an unusual risk, it is the responsibility of line supervision to see that adequate precautions are taken.

Operating, maintenance, design and safety personnel will conduct this audit with the plant manager. I realize, Alan, that this will put a heavy demand on your time at first, but it will ultimately prove to be a time saver. It should eliminate tail-chasing accident investigations.

Safety training must be undertaken—starting at the top. I propose a safety training seminar for supervisors that will require an entire day to complete. The plant manager will be the key man and will explain our safety philosophy and what he expects of his supervisors and foremen in their execution of this philosophy.

I also propose that we invite personnel from the neighboring plants to participate in the seminar and that we return the favor in similar seminars they may hold.

On-the-job safety training should become mandatory. To aid the foremen in the conduct of this training, we ask that a special area or building be set aside as a place to hold safety meetings.

The many recommendations from our central safety office, our insurance carrier and our own engineering personnel must be reviewed, and a program to protect our property with automatic devices developed. Our fire brigade members have made many suggestions concerning training all personnel in the techniques of fire control. I am incorporating these suggestions in an over-all plan for coping with plant emergencies, and recommend that this plan be adopted until we can refine it by test. Information from the safety audits will indicate where we need change, and further changes will be suggested as our safety meetings develop.

Above all, we must make our safety program an active one. Production with safety must become our prime objective if Stardust is to avoid repetition of the disaster we've just experienced.

Kling: How much time did you, as safety director, spend on hazards identification and loss-potential evaluation prior to this disaster?

Webb: That's not my job. The identification of areas of high hazard is the responsibility of the supervisor of each department. That is the purpose of the proposed safety audit. All the safety man can do is provide the tools and ideas, but the carrying out is on the shoulders of the production supervisors and no one else.

Fortney (Humble Oil): Who was responsible for the poor housekeeping that contributed to the spread of the fire?

Webb: In any plant you will find that a foreman will claim responsibility for a certain area, but if you question him about an old scaffold, he will say that the insulators or the painters put it up and that he can't do anything about it. I propose to prepare a housekeeping sheet, giving each supervisor an overlapping area of responsibility. This way, we won't have roads acting as a no-man's land and accumulating garbage.

Unit Process-Safety Audit

Raw Materials:

1. Are any of the raw materials unstable?
2. Is there adequate control of raw-material identification and quality?
3. Is there proper control of storage conditions?
4. Are any toxic raw materials creating an exposure hazard?
5. Are flammable raw materials properly handled?
6. Do the operators have emergency instructions in case of a spill?
7. What provisions have been made for fire control in the storage areas? Will water create problems?

Process (each individual step):

1. Is the reaction exothermic?
2. Are there adequate facilities for removing the heat of reaction safely?
3. What is the effect of foreign contaminants on the violence of the reaction?
4. Are the process intermediates stable?
5. Are safe handling limits of unstable materials known?
6. Are data available on the rate of heat evolution during decomposition?
7. Are there instructions on the operating floor for emergency action (power failure, steam failure, brine failure, water failure, bad analysis, etc.)?
8. Are side products or gases formed by accidental contamination with water, solvents, acid, etc.?
9. Are there adequate facilities for handling such side reactions?
10. What means are there for disposing of the reactants in the event of an emergency?
11. What would be the hazard of sewers during normal operations or during an emergency?
12. What has been done to ensure that operators are trained for emergency action?
13. Are emergency items readily available and in good condition (gas masks, fire extinguishers, etc.)?
14. What would be the consequences of an incorrect proportion of reactants?
15. What about instrument failure—are dual control points needed?
16. What would be the effect of an agitator failure (power failure, dropped turbine, etc.)?

Finished Goods:

1. Is packaging or drumming hazardous from a toxic or a fire point of view?
2. Are the containers properly labeled for toxicity, flammability, chemical stability, etc.?
3. Are proper containers being used?
4. What would be the consequences of a bad spill?
5. Are special instructions needed for containers or for storage and warehousing by distributors? Does the shipping department have operating instructions covering each product regarded as critical?

Fortney: What about weed and grass control?

Webb: These can be controlled by the maintenance group with a suitable weed killer.

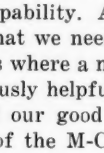
Kling: How about the insurance companies? Did you make full use of the underwriters and inspectors they send to tour the plant with you?

Webb: An insurance carrier makes recommendations based on the risk he appraises. He will not force you to adopt his recommendations but will charge a higher rate if you do not. In a loss such as we have experienced here, you would probably lose your insurance with that particular carrier.

Kling: I feel that we've missed the boat at Stardust with regard to the services available from insurance companies. The engineers and inspectors who come into the plant are not policemen to hit us over the head—they are consultants and specialists in the field of fire-protection engineering. I think we should have regarded these people as consultants who could help us do a very specific job in keeping ourselves in proper shape for fire protection.

Webb: Insurance people prepare their evaluations and recommendations carefully, knowing that they will be caught in the middle if something does go wrong. To not pay heed is futile. We must not only evaluate realistically what we can expect to do with these people, but we must also see that these recommendations are not lost in the rush of production.

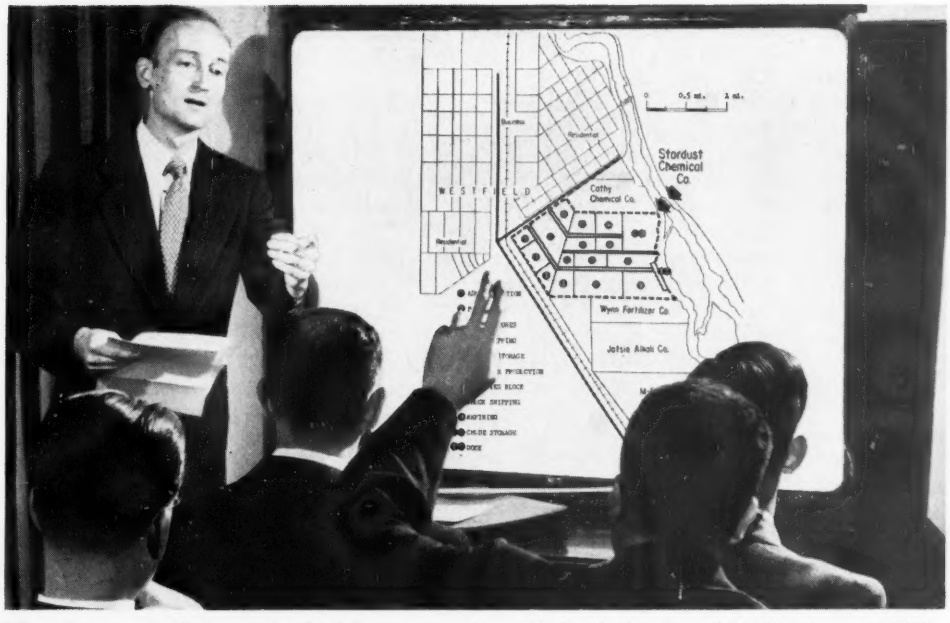
Kling: Mr. Safety Director, it looks to me as if you and I will have to work closer together. But no matter what kind of a program the two of us develop, there will still be emergencies beyond the scope of our capability. And it was very plain in the present case that we needed outside help and needed it badly. This is where a mutual aid group would have been tremendously helpful to us, and so we will now hear from one of our good neighbors down the road—Mr. Gilmore of the M-C Plastics Co.



Mutual Aid Is a Plan for Action

C. L. GILMORE: As our industrial plants have located here and our city of Westfield has grown, we have cooperated to solve many mutual problems to the benefit of our industries and our community. We can do the same in the area of plant emergencies. Since this incident occurred at Stardust, I have inquired about mutual-aid programs now in use in other industrial communities and I believe that such a program would have helped in this incident and would be of real value to all of us in future incidents.

The principle of mutual aid is basic and simple. It is a plan of action whereby assistance by the members is made available to any member having an emergency beyond his ability to control. The membership is not limited to governmental and industrial agencies, but can include the utility companies, construction companies, the newspapers, the radio station, hospitals, doctors, and ham radio organizations.



Members of the mutual-aid group should include local industry, utility companies, construction companies, news media, hospitals, doctors, local fire and police agencies and ham radio organizations.

Assistance is made available upon request of the affected member and, therefore, communications are important. Stardust had trouble contacting the police and fire departments and the other plants when it needed help. Under mutual aid, the communication pattern is prepared and practiced before the incident. Under such a plan, a single call by telephone or radio will alert the members and get the assistance needed.

Both the source and type of assistance will vary with the particular emergency. Mutual aid helps the affected member find what he needs and gets it to him.

A list of what is available from the various members is kept by the organization and when a particular piece of fire equipment, a rescue team or an ambulance is needed, the group knows where it is and can route it to the emergency scene. In some locales, agreements are in effect whereby assistance from other mutual-aid groups will also be available on request by the affected group.

A mutual-aid program is a plan of action, and the alert to the members is the signal to act. For example, the police can set up prearranged roadblocks, which would avoid the congestion we had around Stardust.

The newspaper and radio people have a responsibility to get the news to the public. They don't want to put out an exaggerated account but, in this case, it is partly our fault that they did. Under mutual aid, the press and radio are members, or know that the organization exists, and they have an authoritative source of information. During incidents that have occurred elsewhere, this system has proved most effective in stopping panic and rumor in the community.

Mutual aid is given to a member with the clear understanding of reimbursement to the giving member. This detail must be worked out beforehand so that the giver will have no reluctance to assist, and the user has the confidence that his request will be fulfilled. Also, in most programs, the line of authority is fixed so that the affected member is in charge. With such a plan, we would not have had so many chiefs at this incident.

When you get right down to it, mutual aid is a preparation for an emergency, and a plan for action during the incident. We can form such an organization in our city. We can call a meeting of representatives of industry, government and service groups, and draw up an agreement for mutual assistance. There are many organizations to help us, and the Office of Civil Defense Mobilization in Battle Creek, Mich., will give us a list of such groups to contact.

Of course, an agreement is not enough. We will have to develop our plans for action and practice them. The drill is very important because it gives us an opportunity to work out the "bugs" so that we will operate smoothly and effectively when the real thing occurs.

These programs have proved effective in other communities, and I think we should consider a mutual-aid group for our industrial community.

Armentrout (Pasadena civil defense): Will the new mutual-aid group be made part of the local civil-defense organization?

Gilmore: It is entirely likely in a city the size of Westfield (25,000) that the civil-defense organization is not very active. On that basis, the mutual-aid group will probably be the first step in the civil defense of the community. From what I have seen of other localities, I would guess that the mutual-aid plan will be the backbone of the civil-defense organization.

Groves (Humble Oil, Baton Rouge): Stardust is by far the largest plant in the area. Are the other companies able to supply a significant amount of equipment, or will Stardust carry the whole load?

Gilmore: My own company, M-C Plastics, is a manufacturer of plastics and, as such, does have emergency equipment. Our equipment will be listed with the others, recognizing that probably the brunt of support will fall on Stardust because it is the largest industry in our community.

However, Jafsie Alkali Co., Cathy Chemical Co. and Wynn Fertilizer, although small, have within themselves the potential for a disaster similar to the Stardust incident. Therefore, it is their obligation, and my company's, to become a part of the cooperative group, pooling whatever manpower and equipment resources we may have.

Ward (Kanawha Valley Mutual Aid): Before entering into a mutual-aid agreement, do the various plants have their own in-plant disaster programs?

Kling: It certainly appears that we did not have much of a disaster program before and, from soul searching since our fire, I believe that I avoided responsibility by leaving this up to our safety man and others in the plant.

Certainly, if we organize a mutual-aid group, we will have to develop a first-class in-plant disaster plan ourselves.

Gilmore: I am going to turn this question around and assume that you, Mr. Ward, are a councilman in Westfield. Yes, we do have an in-plant plan at M-C Plastics and it's a nice plan on paper. But, as a result of this incident, we realize that this is not enough. We're going to go out and test our plan, find out what's wrong with it and make it work—and we're going to implement it.

Now, Mr. Councilman, if we do this, and organize a mutual-aid group, will you then go out and organize an active and effective civil-defense organization to protect the community in the same manner of mutual cooperation that we are trying in industry?

Kling: Now we have industry organized and on the ball. But we realize that we are not self-sufficient or self-sustaining—we still need help from outside of industry. One of the first things that happened during this disaster was that all the roads were blocked and help couldn't reach us. We must depend upon the police to give us a great deal of assistance in a situation such as this. And, although we are outside Westfield, we have good relations with the city, and their chief of police, Chief Bias, will tell us how the traffic problem should have been handled.

Police Groups Can Educate the Public

DALLAS W. BIAS: It's easy to see that the city, county and state police, as well as industry in and around Westfield, did not have a workable plan to meet this emergency.

I sometimes feel that the best way to avoid these traffic jams would be, as Will Rogers suggested, to pass a law that during an emergency nobody is allowed on the highway unless his car is paid for. Unfortunately, we can't do that and will have to develop something else.

Stardust Chemical is on the outskirts of Westfield, outside my jurisdiction, and the situation that arose was beyond the capabilities of the city police to handle alone. Therefore, in order to encompass Stardust and all the other industries in the area, an emergency plan will have to include city and state police and the county sheriff.

These police groups will set up a roadblock plan to handle emergencies at Stardust or at any other plant in the area. In such a plan, it is first necessary to agree on one centralized police agency to run communications and direct operations.

Inasmuch as Company A of the state police has its headquarters in Westfield and is responsible for the entire area, I suggest that this company be designated as the clearing point for all emergency police activity in the county-wide emergency plan.

There should be a separate telephone at headquarters that is not used for any purpose except the master emergency plan. The telephone number should be unlisted and should be available to designated personnel at each plant for use during an emergency. Once the plan has been put into effect and the affected plant has called the state police at the special number, each police and fire department will be directed by shortwave or telephone from state police headquarters.

A workable emergency plan will have the following general instructions:

1. In case of emergency, the affected plant will immediately dispatch plant personnel to the nearest roadblock designations in each direction from the plant, to establish and maintain roadblocks until relieved by designated police authority.

2. Plant management will immediately notify state police in Westfield by the emergency telephone number.

3. State police will dispatch the nearest radio-patrol car to the affected plant, to take up station near the plant protection office and establish radio contact with Company A headquarters.

4. State police will, as soon as possible, dispatch a portable radio transmitter to the affected plant and, when communications are established, the patrol car so relieved will take up patrol in the area between the previously established roadblocks.

5. All emergency passes issued by plant management, or the chairman of the mutual-aid group, will be honored in the area for which issued. These passes will be easily recognizable and in a form approved by

Police roadblocks are set up during emergencies at predetermined points to divert through traffic around the disaster area and to assist emergency vehicles coming and going. Periodic practices should be held.

the mutual-aid group to permit the bearer to pass through police lines.

6. Shift passes will also have the area designation printed on them and will be honored when plant management, through state police headquarters, designates which shift (by letter or number) should be passed through the blockade.

7. All plant personnel and shift workers on the relieving shift not holding emergency passes should assemble at designated points outside the affected area at least 30 minutes before shift change, and will be escorted through police lines in large groups, so as not to create traffic or hinder emergency workers.

8. Key personnel for utilities, etc., will be furnished with passes similar to those issued by the various plants. Utility workmen in company trucks or other identified vehicles will be passed into any disaster area without further identification.

9. During emergencies, police communications networks will be restricted, as far as possible, to official use for information and issuance of orders pertaining to the particular emergency.

Just putting this plan down on paper, where only a few management personnel in the police departments will see it, will not be enough. Written plans, when not in use, are easily misplaced and, when they have not been practiced, valuable time is lost reading them when they are needed.

Therefore, a workable solution, particularly for the police departments, is to practice the plan at least once a month throughout the year. I do not mean that we should actually divert traffic; just send the men out to the key traffic diversion points throughout the county, taking one zone each month.

This system will familiarize patrol and communications personnel to the extent that they will know the key traffic points without referring to the written plan. Our reflexes will be geared, like a prize fighter's, to react automatically as one unit at the strike of disaster.

Many people hate to have police officers on the corner telling them where they may or may not drive and, for our plan to be successful, we must overcome this attitude. I suggest that, during the practice runs, the men pass out slips of paper prepared by the mutual-aid group, explaining that we are simulating an emergency and, if an actual disaster did occur, they would be diverted from this to an alternate route. This will educate people to the plan and, when an emergency does occur, they will observe the roadblocks without question.

Guynes (Humble Oil, Baytown): Will you have enough manpower to relieve plant personnel at roadblocks quickly?

Bias: I would say that we will have two-man patrol cars in the key areas at all times and that plant

The police problem and its solution

The Problem:

1. Diverting through-traffic around the disaster area.
2. Assisting emergency vehicles to enter and leave the area.
3. Eliminating all non-essential traffic.

The Solution:

1. Predetermine emergency routes over which through-traffic can be diverted with a minimum of inconvenience.
2. Stop and turn back all non-essential traffic.
3. Seal off all routes that are to be used by emergency vehicles. Clear this area of unauthorized vehicles.
4. Educate the public in advance to:
   a) Stay away from the affected zone.
   b) Avoid use of the telephone.
   c) Turn on the radio for news and instructions.
5. Develop a comprehensive, but simple and flexible, plan for emergency traffic control.
6. Present this plan for thorough study and acceptance by all those who will participate in its execution.

personnel should not have to man the roadblocks longer than three or four minutes.

Stewart (Signal Oil, Houston): Will a private citizen have the authority to direct traffic?

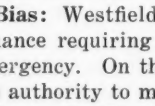
Bias: Westfield, like most other cities, has an ordinance requiring a citizen to assist an officer in an emergency. On that basis, I can give plant personnel the authority to man the roadblock.

Leonard (Sheriff's Dept., Houston): Have you taken steps to upgrade and train the security personnel in the plant? Local police authorities can help.

Kling: We probably have not given as much importance to this job as we should—hiring the halt, the lame and the blind as guards. We now realize that our guards were not capable of handling the situation and we'll have to stop looking at this as a terminal job but as an extremely important part of our loss prevention.

We will have to work closely with the three police agencies to make sure that our security force is adequate and tied into the over-all emergency plan.

It is apparent that all the things we have talked about must be tied together by communications. To talk about this aspect, we have Mr. Velie of the Westfield County Telephone Co.



Get the Right Word To the Right People

ROBERT R. VELIE: Every plant has enough of its own fire, police and medical protection to cope with the minor everyday emergencies that might arise. When a major, unforeseen emergency springs up, however, a plant or industry needs help from its neighbors and the community. Thus arises the need for a mutual-aid group. I'm glad to hear that we are to have one in Westfield and I can tell you that the telephone company will be a part of it.

Mutual aid among chemical plants must be specialized for the industry, and so must the telephone service.

Basically, I want to talk about communications in the technical sense. The British have a better word for communications than we do—they call the mechanical means of communications "signals." I will talk about signals and not the message itself.

For each communication, the signals must be fast, reliable and flexible—they must get the message to the right people. And they must be able to do this in spite of the emergency and its effect on people.

Now, in this recent disaster at Stardust, the company should also have taken steps to get the message to the people not directly involved, the general public. This is a public relations responsibility and every company, to be a good neighbor, must have good public relations and public planning.

To meet the criteria of speed, reliability, flexibility and accuracy requires planning. And it must be highly imaginative planning to handle disasters.

With these ideas in mind, let's look at Stardust and see what happened to its communications, and how advance planning could have reduced its difficulties.

First of all, a shipping operator ran to turn in the alarm at a post in the adjacent chemical unit. We wonder how far he had to run. Were there enough alarm boxes spread strategically throughout the plant? Had the operator been trained in ways to turn in the alarm by other methods such as administrative telephones or even by walkie-talkie? The telephone company would be glad to come into the plant, look at the cable distribution system and suggest improvements.

Secondly, some passing motorists saw the fire and continued into Westfield where they spread rumors. Good planning would have included getting the true story to Westfield first. The special telephone suggested by Chief Bias would fulfill this purpose, and the telephone company will be glad to install it.

When a disaster occurs, the police, press and fire department will be swamped with calls, and so will the telephone company. We will know of the trouble before most people, because the switchboard lights up, and the equipment races. We can help avert public panic and handle the emergency if you notify us of the facts immediately so that we can tell callers.

If people call your plant and can't get through because your switchboard is busy, they will call our operator and say "Operator, I would like the Stardust Chemical plant." If you authorize her to, our operator will screen these calls and only connect the emergency ones. There's not much point in a salesman calling for an appointment when the plant is burning down.

Good prior planning would have also called for some

Alarm boxes should be placed strategically throughout the plant to minimize the distance an employee must run to turn in the alarm.

of Stardust's switchboard trunks to be outward only. These trunks should use the central office battery, in case Stardust loses power.

Telephone repair service should be notified of the emergency so that it can send a repair crew out to the plant. A mobile unit with extra telephones can also be sent.

A word about public relations. The news media can be a blessing as public relations assistants or a plague as passers of rumors, depending on how they are handled. Stardust didn't handle them at all. Good planning would have made it the duty of the industrial relations department to meet the reporters, give them a statement and guide them to safe vantage points.

Radio and TV stations could be asked in advance to provide a common loop over which plant management could broadcast to the people what was actually happening, what the danger was, what was being done about it and how the public could help by staying home, listening to the radio and not using the telephone.

Radio stations like to perform public services to improve their image. And if the press and photographers are given equal opportunities, they won't try to scoop one another with gruesome pictures or rumors that relatives see and hear before the truth.

Finally, there was no central control of the emergency fighting forces. Control implies that someone is designated as chief and that a control center is set up where the fire fighters can communicate with this chief, and vice versa. The control center should be a communications center. It can be a police car, a police communications trailer, a mobile radio-equipped plant unit, a mobile ham operator's car, a reserve or national guard communications unit, a telephone company mobile PBX switchboard or a civil defense unit.

Good planning would have found out what was available locally that could be used as a control center, and arrangements made to practice with it in advance.

Communications in emergencies consist of getting the right word to the right people quickly and accurately. Because emergencies are never alike and never foreseen, planning for communications requires the utmost in imagination to predict what might happen and to discover all the available alternatives for action.

Boileau (RCA, Camden, N. J.): We've talked about police, communications and everything else, but we've left out the men who actually put out the fire. How about the fire chief?

Kling: This, of course, will be a very important part of our in-plant program and the mutual-aid arrangement.

Boileau: Will arrangements be made to brief the local fire chiefs on the special hazards in the Stardust plant? Will local fire departments cross jurisdictional lines to fight industrial fires? Will the city fire chief direct operations within the plants?

Velie: Most fire departments in a locality belong

to an association that arranges for community coverage and crossing political lines when necessary. I don't know how they work out the costs, but they do get the fires out.

It should be mandatory for local fire chiefs to visit the plants, to become familiar with the hazards. Many insurance companies require this.

Kling: We at Stardust can't turn over all our problems to mutual aid. We will have our own fire chief who will be in charge of all fire-fighting facilities. We can't have six different chiefs coming in and trying to fight fires in six different directions.

We will have all the city and volunteer chiefs in the area come to tour our plant, and we will have joint drills with them. But the fact still remains that, in case of an emergency, our fire chief will direct operations and the others will take orders from him. We will see that he is competent and well-trained.

Stewart (Signal Oil): Suppose a plant is located completely within the city limits. Won't the city fire chief have charge then?

Gilmore: It makes little difference whether the plant is inside or outside the city limits. The responsibility for directing emergency operations must lie with the plant that is affected. Otherwise, the problem arises of too many chiefs and too few Indians. In our community, there is even the chance of having several different fire organizations involved.

All these organizations must work under a single leadership and that leadership is best given by the plant fire chief, simply because he is the one who knows most about what is taking place.

Kling: The final member of our panel is Mr. Fauber who represents Stardust's top management. He will summarize what the company has learned from this experience and tell us the plans for reform.

Top Management Must Plan for the Future

JAMES E. FAUBER: Top management of Stardust now realizes, as a result of this disaster, that preparedness and preplanning for emergencies is as integral a part of our operations as meeting schedules and making production. Failure to recognize this fact has put our company in the unfortunate position of curtailing production, failing to meet our customers' demands and making costly repairs.

Furthermore, in this incident, we have threatened the very lives of our employees and even the people in the surrounding community. Our biggest single error was the failure of top management to recognize and endorse emergency and disaster control activities.

With these thoughts in mind, we are instituting a reorganization of our management forces to establish a preplanned security program for ourselves and our neighbors at all of Stardust's plants.

Experience has shown that we must maintain adequate around-the-clock emergency crews, on-call disaster-control personnel and supplemental industrial mutual-aid societies. But first, we must put our own house in order before we even consider mutual aid.

Once we have become as self-sufficient as possible, we can feel able to work with the neighboring industries and to join mutual aid.

The first step in our new program will be to establish two management committees in the plant—an administration committee, made up of top plant management people, and a subordinate work committee.

The first of these will meet monthly and will be comprised of the plant manager, as chairman, the operations superintendent, the chief engineer, the director of industrial relations and the disaster-control coordinator. This committee will be the policy group for disaster control and will be responsible for formally approving all in-plant emergency procedures as they are designed by the subordinate committee.

The subordinate work committee will meet every other week, and will be responsible for actually administering the in-plant program. It will be chaired by the disaster-control coordinator and will include as members the safety director, maintenance superintendent, operations superintendent and plant-protection supervisor.

The function of this group essentially will be to implement the entire program with a workable schedule of training activities, selection of disaster-control personnel and the coordination of our plant activities with other plants in an organized mutual-aid effort.

We realize that adequately trained shift crews, strategically placed emergency equipment and a reliable alarm system could possibly have controlled the past incident. The responsibility for these matters will be placed with each area department superintendent. These people must see to the safety of their departments as well as the housekeeping, including grass and weed control. If they have a safety hazard, they will put in a safety work order to the maintenance department, which will give it immediate attention.

To properly prepare his department for emergencies, each superintendent must evaluate and assign his personnel to disaster-control positions within his own department. He is concerned with his department—not the whole plant. He must visualize every conceivable potential disaster and prepare step-by-step control procedures. Then, he must prepare a department layout that will show his process equipment and evacuation routes.

Departmental communication procedures will be developed, utilizing the available equipment in each department, and tying it in with the total plant picture. Use of this equipment must be practiced, and a procedure of accounting for personnel developed.

These procedures will be more complicated for the maintenance department, particularly personnel accountability, but again, this department will have its own responsibility in the disaster-control program.

Shift emergency crews are now being organized at Stardust, made up of men who can be released from their assignments to answer any emergency alarm. Organization and training of these crews has been assigned to the plant protection supervisor who is a

Under Stardust's plan for reorganization, shift emergency crews will be formed and will practice disaster control at least once each year per team.

member of the plant disaster-control work committee.

The plant engineering department will set up our plant communications system, working with Mr. Velie, to incorporate an alarm system on telephones, which we will also install at the other Stardust plants. This same system will activate the emergency crewmen and disaster-control personnel.

We now recognize that inadequate communications can disrupt our well-laid plans. The telephone company is installing private separate lines, and steps have been taken toward installing a two-way radio system in vehicles and at strategic points in the plant.

This equipment is expensive but will be amortized by the maintenance department, which will use it to speed its operations, in probably less than two years. Experience elsewhere has shown that this can be done.

We will also establish a disaster-control center, which could also be called a communications center, at a strategic point. In this center, we will have a telephone central, a radio base station, alarm system control and all the tools necessary for efficient command.

Also being prepared is a manual containing all pertinent operating instructions, the duties and responsibilities of all members of our organization, a mutual-aid directory and the departmental emergency procedures. This job falls back on our department superintendents. They make the plans, put them in writing and enter them in the manual.

This manual will actually be the bible for our disaster program. Copies will be distributed to plant management, disaster-control personnel and to all plant departments. Our employees must be educated and kept well-informed.

Most important, all personnel must understand their duties, degree of authority and their responsibilities before, during and after a disaster.

It's a tremendous education program and will take a long time. We will train our people on company time, and we anticipate that perhaps 10-20,000 hours per year could be devoted to this.

Stardust Chemical is now in the process of a slow and tedious rebuilding program. Of prime importance will be consideration for more and better sprinkler and deluge systems, automatic alarms and explosion-proof conduits. We know that the fire underwriters and the National Fire Protection Assn. and many others will be glad to give us advice.

Our teacher has been disaster, our tuition costly, but the lesson has been absorbed by all of us. From now on, preparedness is our watchword.

Barsalou (Humble, Baytown): How often should dry runs of disaster procedures be held?

Fauber: Dry runs should be conducted at least once a year for each on-call emergency crew. For the first two years, each should have two a year.

Yandell (Humble, New York): How much do you estimate your new program will cost?

Fauber: The cost of this program could be based on any reasonable average hourly rate, such as $5. A minimum of 10,000 man hours per year for a plant of 1,000 employees should be devoted to disaster-control activities. Any equipment investment would, of course, be extra.

Armentrout: How will the control center be staffed?

Fauber: It will be staffed by members of the on-call team on a 7-day, 24-hour basis.

Kling: Gentlemen, this concludes our panel discussion. You've heard how Stardust made mistakes in the past and how we intend to avoid these mistakes in the future. The past is prologue, the future will be a different story.

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Meet the Panelists

KLING

WEBB

GILMORE

BIAS

VELIE

FAUBER

ALAN L. KLING *is director of loss prevention for Olin Mathieson Chemical Corp. He is a graduate chemist but has been involved in fire and safety work for a number of years. During the war, he was closely associated with the development of incendiary weapons and the protection of military aircraft from destruction by fire. Kling is an active participant and committee member in several technical societies including American Soc. of Safety Engineers (ASSE), Soc. of Fire Protection Engineers (New York chapter president), MCA, Compressed Gas Assn., and National Fire Protection Assn. (NFPA).*

HENRY E. WEBB, JR., *is safety director at Monsanto Chemical Co.'s Nitro, W. Va., plant. A graduate of Roosevelt University in Chicago, he has worked in the atomic energy field as an operator at Oak Ridge National Laboratory and in research and development with Argonne National Laboratory. Webb entered safety engineering with Argonne and continued this work with Food Machinery and Chemical's Chlor-Alkali Div. and with Monsanto. He is also an active member of many societies including ASSE, NFPA, National Institute for Disaster Mobilization (NIDM) and National Soc. for the Prevention of Blindness. He is past president of the Kanawha Valley Industrial Emergency Planning Council (KVIEPC).*

C. L. GILMORE *is plant safety director at Monsanto's Plastics Div. in Texas City, Tex. A chemical engineering graduate of Rensselaer Polytechnic Institute in 1942, he is a registered P.E. both in Pennsylvania and Texas. Prior to joining Monsanto in 1951, he served with Standard Oil Co. of La. and the Hagan Corp. Gilmore is another member of ASSE and also of the Safety Committee of the Texas Chemical Council. He has represented his plant on the local Industrial Mutual Aid Society since 1956 and is recording secretary and executive committee member of the group.*

DALLAS W. BIAS *is chief of police of Charleston, W. Va. He has served as a policeman in that city for 22 years, with time out for the army during World War II and the Korean War. Chief Bias has held his post for five years, having risen from the rank of patrolman.*

ROBERT R. VELIE *is staff supervisor and deputy security control officer for the Chesapeake and Potomac Telephone Co. of W. Va. He began his career with American Telephone and Telegraph and transferred to the Chesapeake and Potomac in Washington in 1949. In 1953, he moved to W. Va. and was plant manager in Clarksburg and then Charleston until 1959. Memberships include American Soc. for Industrial Security, Army-Navy club and several other service and community organizations. He is president of KVIEPC. Long associated with the armed forces, Velie is a colonel in the South Charleston reserve unit, Signal Corps.*

JAMES E. FAUBER *is safety coordinator at the Pittsburgh Plate Glass Co., Chemical Div. plant, Natrium, W. Va. and is responsible for the in-plant disaster-control program. He has a B.S. degree from West Virginia University and is a former athletic coach and school teacher. Fauber was one of the founders of his area Industrial Mutual Aid Organization and its first general chairman. Memberships include ASSE, NIDM and various community organizations.*

Shortcuts in Distillation Design

Fast and simple calculations with a chart and nomograph show entrainment effect on bubble-cap tray efficiency.

H. M. JONES, JR., *Union Carbide Chemicals Co., Charleston, W. Va.*

For bubble-cap tray columns, Fair and Matthews[1] discuss several methods of calculating entrainment and flooding, and from them the wet-tray efficiency. According to these authors, the method for finding entrainment correlates with various experimental data to within ±20%. The chart and nomograph presented here (next page) simplify use of these equations.

From Eq. (1), below, you can find the flow parameter[2] that is defined as

$$F_P = (L/G)\,(\rho_V/\rho_L)^{0.5} \qquad (1)$$

With Eq. (2) you can find a capacity parameter that is a simplification of the Souders-Brown coefficient.[3] The simplification is as follows:

$$C_P = U_o\,[\rho_V/(\rho_L - \rho_V)]^{0.5}$$
$$= (G/3{,}600\,A\,\rho_V)\,[\rho_V/(\rho_L - \rho_V)]^{0.5}$$
$$= (G/3{,}600\,A)\,[\rho_V\,(\rho_L - \rho_V)]^{-0.5}$$

If ρ_V is small, the equation reduces to:

$$C_P = G(\rho_V\,\rho_L)^{-0.5}/3{,}600\,A \qquad (2)$$

The chart and nomograph on the next page use the flow and capacity parameters given in Eqs. (1) and (2) to provide wet-tray efficiency, percent flood and entrainment. Their use is subject to these limitations:

- System is low- to nonfoaming.
- Weir height is less than 15% of tray spacing.
- Bubbling area occupies most of area between weirs.

Actual entrainment can be expressed as $\psi L/(1 - \psi)$ lb./hr. Wet-tray efficiency, as a function of dry-tray efficiency and entrainment can be expressed:

$$E_W = E_D/[1 + (E_D\,\psi)/(1 - \psi)]$$

Try an example

The following conditions are specified for a distillation column:

Liquid rate (dry basis), L	16,800 lb./hr.
Vapor rate (dry basis), G	30,000 lb./hr.
Liquid density, ρ_L	56 lb./cu. ft.
Vapor density, ρ_V	0.16 lb./cu. ft.
Tray spacing, T	15 in.
Vapor flow area, A	13.7 sq. ft.
Dry-tray efficiency, E_D	90%

Determine the percent flood due to entrainment, the entrainment and the wet-tray efficiency.

From Eqs. (1) and (2), $F_P = 0.03$ and $C_P = 0.20$.

To use the chart, begin with the F_P value of 0.03 on the abscissa and move vertically upward to 15-in. tray spacing. Then cross horizontally to the C_P line of 0.20. Read percent flood from the upper abscissa (84%). Drop vertically downward to the F_P parameter (0.03), and read the entrainment on the left ordinate (0.19 mole/mole of gross downflow).

Value of the entrainment and dry-tray efficiency can then be used, on the nomograph to the right of the chart, to find wet-tray efficiency (75%).

Actual entrainment is

$$\psi L/(1 - \psi) = (0.19)\,(16{,}800)/(1 - 0.19)$$
$$= 3{,}940 \text{ lb./hr.}$$

Nomenclature

A	Available vapor flow area, sq. ft.
C_P	Capacity parameter, ft./sec.
E_D	Dry-tray efficiency (without entrainment).
E_W	Wet-tray efficiency (with entrainment).
F_P	Flow parameter.
G	Vapor mass rate, lb./hr.
L	Liquid mass rate, lb./hr.
T	Tray spacing, in.
U_o	Vapor linear velocity based on available vapor flow area, ft./sec.
ρ_L	Liquid density, lb./cu.ft.
ρ_V	Vapor density, lb./cu.ft.
ψ	Entrainment, mole/mole of gross downflow.

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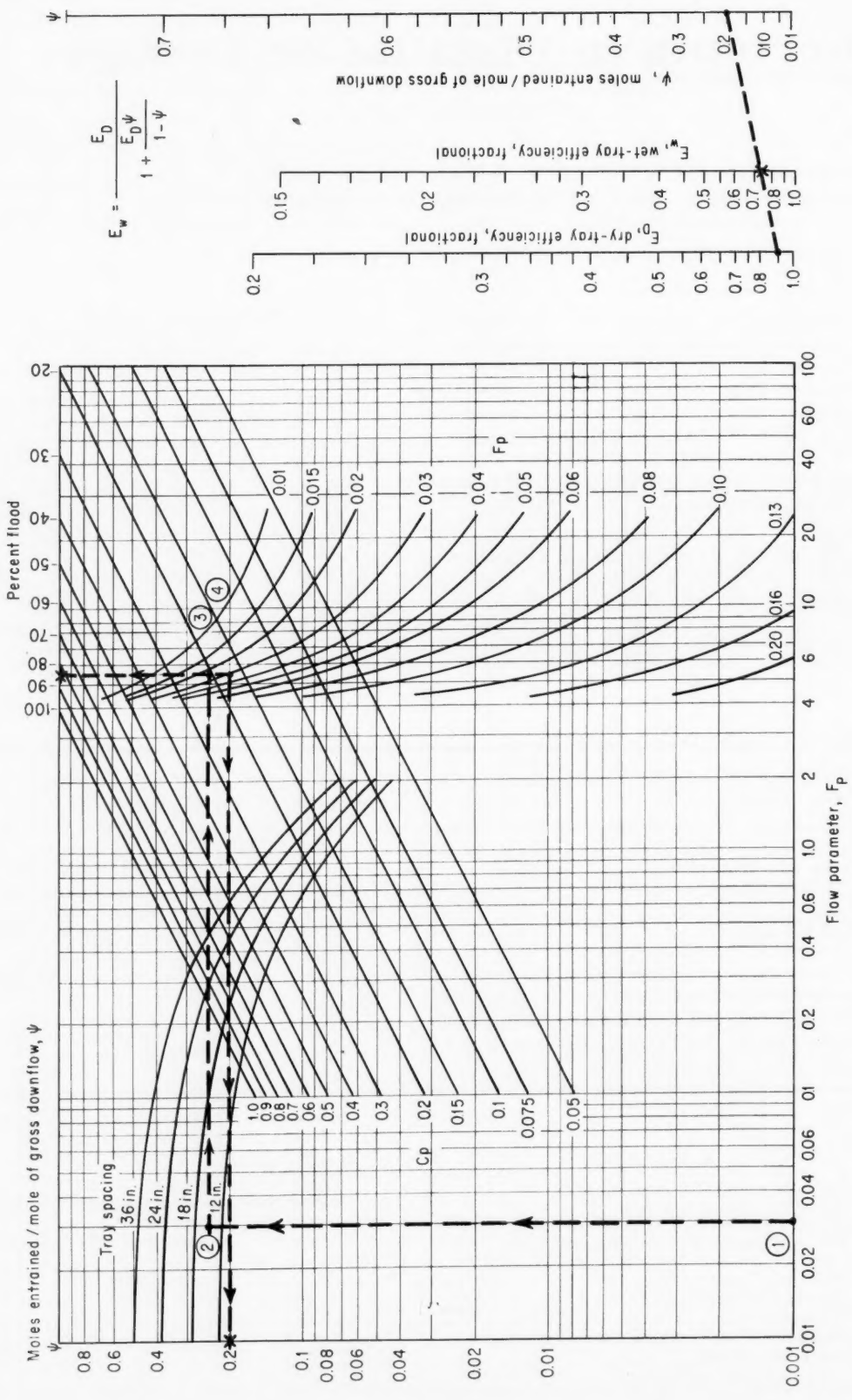
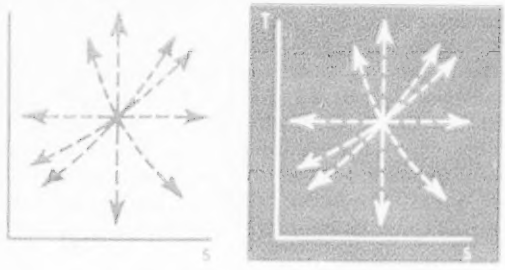
Charts find percent flooding and fraction of entrainment, then . . . . . . find wet-tray efficiency



Interpret
Thermodynamics . . . Correctly



Some Common Errors in Thermodynamics

Many long-established errors in textbooks on thermodynamics result from incorrect analysis of basic principles. Here is an explanation of some mistakes and their correct analysis.

MICHAEL R. CANNON, *Cannon Instrument Co.*

Many textbooks define P incorrectly in the term $\int PdV$, for evaluating the work done by an expanding gas. The correct definition of P is that it is the pressure of the expanding gas and not the opposing pressure of the surroundings. This can be illustrated by the following problem.

A perfect gas is confined in a vertical cylinder by a frictionless piston held in place by a latch. The space above the piston is perfectly evacuated. Additional data are:

Cross-sectional area of cylinder = 1 sq. ft.
Original position of piston = 2 ft. above bottom of cylinder.
Original pressure of gas = 10 psia.
Weight of piston = 150 lb.

What is the velocity of the piston after it has moved vertically one foot? What conclusion can you reach regarding an advantage of irreversible processes?

From the first law, we can say that the work done by the expanding gas must appear as energy but not necessarily as work energy. The mathematical statement is:

$$\int PdV = \int P'\,dV + (MU^2/2g) + \Sigma F$$

where

P = Pressure of gas.
P' = Opposing pressure of surroundings (150/144 = 1.04 psia. in this case).
M = 150 lb.
g = 32.17 ft./sec.^{2}
ΣF = Friction.

In this problem, friction is zero, therefore:

$$\int PdV = \int P'dV + MU^2/2g$$
$$NRT \ln (V_2/V_1) = P' (V_2 - V_1) + 150\ U^2/64.4$$

Since $NRT = P_1 V_1$:

$$P_1 V_1 \ln (V_2/V_1) = P' (V_2 - V_1) + 150\ U^2/64.4$$
$$(10)\ (144)\ (2) \ln (3/2) = (150)\ (1) + 150\ U^2/64.4$$
$$U = 20.8 \text{ ft./sec.} = 14.2 \text{ mph.}$$

If one were to use the opposing pressure of the surroundings in evaluating the work done by the gas (as some authors advocate), then he would arrive at zero velocity for the piston and it would follow that the muzzle velocity of all projectiles is zero.

The conclusion is that the bigger the difference between P and P', the more work energy is available for conversion into kinetic energy. Since the difference between P and P' is a measure of irreversibility, it follows that speed is an important advantage of irreversibility.

Another advantage not illustrated by this problem is size. In general, the more irreversible the process is, the smaller the equipment will be for a fixed duty. This matter is easily illustrated by designing two heat exchangers for the same duty (duty is measured in terms of the Btu./hr. to be transferred). The more-irreversible heat exchanger will be the smaller. A reversible heat exchanger would have a differential temperature difference between the heating medium and the medium being heated and, therefore, would be of infinite size for a finite duty.

Referring to the first problem, note that although the total process is irreversible, the gas expands reversibly. It is not uncommon to have reversible components in an irreversible process. The test of reversibility is the magnitude of the driving potential that is causing the process to occur. If this potential is infinitesimal in size, the process is reversible and if it is of finite size, the process is irreversible.

In the preceding problem, the potential causing movement of the piston is $(P - P')$. This is a finite quantity and the over-all process is, therefore, irreversible. The location of irreversibility is at the piston face. The pressure of the bulk-body of gas molecules is the same everywhere and consequently the work quantity is easy to evaluate since the gas expands reversibily.

If the perfect gas of this problem were replaced by a real gas such as air, the solution to the problem would be essentially the same, because a speed of 14.2 mph. is too low to effect a significant pressure drop caused by friction within the gas phase.

Gas does the same work in all cases

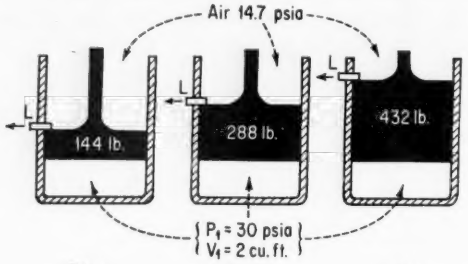


Fig. 1 Fig. 2 Fig. 3

If, however, the speed were high, so that a significant pressure drop due to gas friction did occur, then in the evaluation of the term $\int PdV$, it is necessary to use the pressure of the gas at the face of the piston. This pressure, of course, will be lower than the average pressure of the bulk of the gas. To evaluate the $\int PdV$ for such cases usually requires experimental data.

Gas Expands Into Infinite Vacuum

Many textbooks in physical chemistry and chemical thermodynamics contain another important error, stating that when a gas expands into an infinite vacuum no work is done and no gas temperature change will occur if the process is adiabatic. This matter is very important and will be illustrated by the following problem.

A perfect gas is confined in a rigid immovable cylinder that is connected to an infinite vacuum by a small horizontal pipe containing a valve. The valve is opened for a short period of time during which the pressure within the cylinder falls to one-half its initial value, whereupon the valve is closed. Molal specific heat capacity of the gas at constant pressure may be assumed to be constant at 7 Btu./(lb.-mole) (° F.). Initial gas temperature is 100 F.

Calculate (a) the temperature change of the gas that remains in the cylinder and (b) the work done by the gas per gram mole that remains in the cylinder.

The gas left in the cylinder expanded from its initial state to its final state reversibly since at no time was there a finite pressure gradient in this gas. The over-all process is irreversible but the irreversibility occurs over the valve and details of this are not needed.

Once again, we have an over-all process that is irreversible but the process contains a reversible component; namely, the gas that did not leave the cylinder expanded reversibly. The process would be adiabatic since it occurs rapidly.

$$\Delta T = T_1\left[\left(\frac{P_2}{P_1}\right)^{(K-1)/K} - 1\right]$$

$K = C_P/C_V = 1.4.$
$\Delta T = 560\,[(0.5\ P_1/P_1)^{0.286} - 1]$
$\Delta T = -101$ F.
$W = Q - \Delta E$
$Q = 0.$ (Since the process would occur so rapidly, there would not be enough time for Q to be significant.)
$W = \int PdV = -\Delta E = -NC_V\,\Delta T$
$W = -(1/454)\ (5)\ (-101)\ (778) = 866$ ft.-lb.

Where did this work energy go? To answer this, simply ask "What did the molecules push?" It is clear that they pushed molecules of gas out of the cylinder. So the work energy done by the molecules remaining in the cylinder now exists as kinetic energy of molecules outside the cylinder. The energy transformations are, therefore, in balance.

Another Example of Incorrect Concepts

The pistons and cylinders shown in Figs. 1, 2 and 3 are similar to figures used in *Chem. Eng.*, Sept. 1953, p. 241, in which the author states that the expanding gas does a different amount of work against each piston of different weight. For the author to be correct, it would be necessary for the molecules to push lightly against a low-weight piston and to push with greater force against a heavily loaded piston.

This confusion is caused by the erroneous assumption in most thermodynamic books that work done and work received are equal. Never equal in any practical process, they are only equal in reversible ones.

Assume that the pistons in Figs. 1, 2 and 3 are frictionless, that all three latches are pulled simultaneously, and that the perfect gas in each case is maintained at constant temperature. Which gas does the most work per foot of piston travel?

The same work is done in all three cases. The gas expands reversibly even though the over-all process is irreversible. The piston of Fig. 1 will have more kinetic energy than that of Fig. 2, which in turn has more than that of Fig. 3. The highest speed is obtained with the most irreversible process. Molecules do not have brains. They push against a light piston or a heavy piston with the same force and, therefore, all three gases do the same amount of work per foot of travel. The work done by the gas appears in the surroundings not only as work energy but also as kinetic energy.

Meet the Author

MICHAEL R. CANNON *retired last year as professor of chemical engineering after more than 25 years of service at Pennsylvania State University. While he has been active in viscosity, extraction and petroleum composition research he considers teaching his major interest. Dr. Cannon received the B.S., M.S. and Ph.D. degrees in chemical engineering from Penn State and is a member of Phi Lambda Upsilon, Sigma Xi, Alpha Chi Sigma, ACS and AIChE.*

He plans to work more closely with developments in Cannon Instrument Co., of which he is the president. He founded the company to manufacture an improved viscometer he personally developed.

Scaleup for Non-Newtonian Fluid Flow

Articles in This Series

1. Designing laminar-flow systems, June 12, 1961, p. 243.
2. Determining end of laminar region, June 26, 1961, p. 127.
3. Turbulent flow—a historical review, July 10, 1961, p. 147.
4. Designing turbulent-flow systems, July 24, 1961, p. 143.
5. **How to Handle Slurries.**
6. Methods for obtaining data.
7. How to interpret data.

How to Handle Slurries

Velocities become critical when scaling up slurries, since settling must be avoided. Here are some practical equations to use when designing piping systems.

RICHARD LeBARON BOWEN, Jr., *Coated Textile Mills, Inc.*

There is one serious limitation to the scaleup methods we've discussed in Parts 1-4 of this series. The techniques are intended for non-Newtonian fluids that are not time-dependent. This, therefore, excludes materials where shear-stress changes with time at a constant rate of shear (thixotropy or rheopexy). These are reversible phenomena.

But there should also be no irreversible changes in the physical or chemical nature of the fluids tested during the time of the experiments. Polymer solutions should not react chemically, and solid particles in suspensions should not dissolve, settle, or change their physical nature. (The term "suspension" is sometimes restricted to systems that do not tend to settle.) Settling is an extremely important consideration when pumping solids through a pipeline by suspending the material in water or other fluid. There are a number of commercial installations for pumping a variety of solids in liquids (usually water) through 6 to 16-in. pipe over hundreds of miles.[1, 2] Thoria-urania slurries are possible fuels for one type of homogeneous nuclear reactor.[3] Obviously, settling cannot be tolerated in any of these systems.

Minimum and Standard Velocities

There are two critical velocities to be considered when settling in slurries is investigated. The first is the *minimum velocity*, below which particles settle from the liquid and partially or totally block the channel. Velocity can then be increased to the *standard velocity*, above which homogenous flow takes place with particles uniformly dispersed throughout the liquid. Between the minimum and standard velocities is the heterogeneous flow region.[4] Here, there appears to be a concentration gradient from the top to bottom of a horizontal pipe.[5] Solids in this region travel at a velocity below the fluid velocity. Pressure drop is higher than normal, presumably because the fluid has to percolate through a suspension of more slowly moving solids.

How to Calculate Critical Velocities

The most important factors in determining critical velocities in slurry settling are size of the particles and their apparent density when immersed in the fluid (buoyancy).

A correlation from the Froude number (representing gravitational forces) and the Reynolds number (for the viscous forces) has been developed by Spells:[4]

$$\rho_l V^2/\rho_e g_c \zeta = k_s (DV \rho_m/\mu_l)^{0.775} \qquad (41)$$

where ρ_l is liquid density, ρ_e effective density (solid density $\rho_s - \rho_l$), ρ_m mean density of the slurry, ζ mean particle diameter, μ_l viscosity of the suspending medium, and k_s a constant equal to 0.0251 for minimum velocity and to 0.0741 for standard velocity. Only an approximate agreement with published experimental results was obtained. The relationship seems to hold only for particles between 50 and 500 microns.

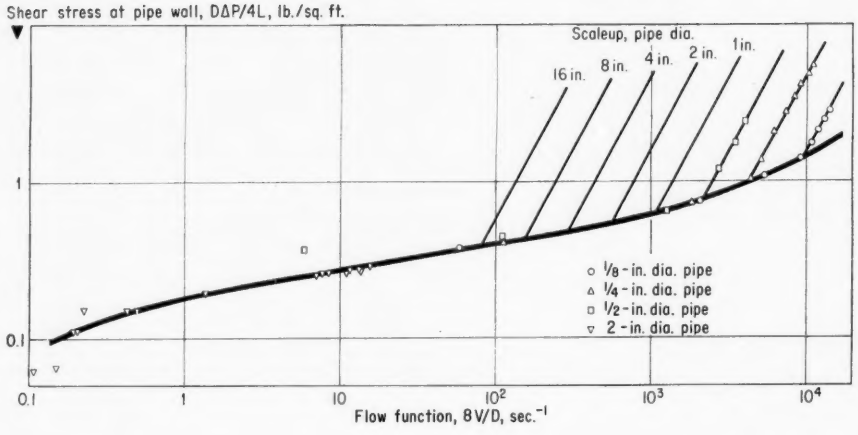
Eq. (41) may be rearranged easily to the following by solving for V and equating V to $Q/352D^2$ (where Q is in gpm.):[6]

$$Q = 352\, D^2 (k_s \rho_e g_c \zeta/\rho_l)^{0.816} (\rho_m D/\mu_l)^{0.633} \qquad (42)$$

For any particular fluid system, this reduces to

$$Q = 352\, A k_s^{0.816} D^{2.633} \qquad (43)$$

where A is a fluid system constant. With this equation, it is a simple matter to calculate either mini-



Typical flow diagram, for a 23% lime slurry, shows branch lines for non-Newtonian turbulent flow.

mum or standard flow conditions for a slurry for the particular pipe sizes drawn on the pipe-flow chart (see Part 4).

Handling Small Particles

Some recent work by Cairns has been published on dilute small-particle suspensions.[7]

Mean particle size of the four solids used varied from about 15 to 30 microns, density from 168 to 1,200 lb./cu. ft., and weight concentrations from 5 to 15%. It was assumed that these suspensions acted like Newtonian fluids, i. e., shear-stress under laminar conditions was proportional to shear-rate. In horizontal pipes, as velocity decreased with a particular solid, there was a critical velocity (V_m) at which a moving bed formed, and at a slightly lower (2 to 15%) velocity (V_f), a stationary or fixed bed formed. These velocities were determined visually in transparent pipe and were fairly reproducible. For any particular solid, critical velocities were independent of the range of concentrations studied.

Two empirical equations appear to fit the data:[7]

$$V_m = 1.9\, D^{0.2}\, (\rho_s/\rho_l)^{0.3} \qquad (44)$$

$$V_f^{0.85} = 1.6\, D^{0.2}\, (\rho_s/\rho_l)^{0.3} \qquad (45)$$

Data used by Spells[7] in deriving Eq. (41) is at variance with Eq. (44), but he used much larger particles.

It has been suggested that an improved form of Eq. (41) is[7]

$$V^2/g_c\, \zeta = 9.8\, C^{0.3}\, (DV\, \rho_l/\mu_l)^{0.3}\, (\rho_s/\rho_l)^{0.6} \qquad (46)$$

where C is concentration, % by volume.

It is further recommended that this equation be specifically limited to particles having mean diameters of 240 to 380 microns and a density of 162 lb./cu. ft. The minimum velocity used by Spells was apparently determined from pressure drop considerations. It is evident that further work needs to be done on these systems but, until that time, a proposed system should be checked with any of these applicable equations.

Usual Reynolds Number Not Correct

It is often assumed that the only criterion needed to avoid settling of a suspended solid is turbulence. Some people claim that if velocity is just within the turbulent region, stratification of the liquid and solid phases will be prevented.[1]

The work on which Eqs. (44) and (45) were based indicated that in at least one case (8% by weight of tungsten powder of sp. gr. 19.3 in water) settling commenced (as the velocity decreased) at a Reynolds number of about 30,000.[4] The Reynolds number was calculated using mean density (ρ_m) and viscosity of suspension (μ_m). However, viscosity was calculated from a theoretical equation using viscosity of the suspending liquid, concentration of the solid, and concentration at zero fluidity. Even at velocities of over five times the settling velocity (Reynolds number of 161,000) a concentration gradient was detected from the top to the bottom of the 1-in.-square horizontal pipe used.

It is suggested that the minimum Reynolds number of 2,000-3,000 used by other workers for the "homogeneous" transport of subsieve particles in horizontal flow is not correct. This minimum Reynolds number does not necessarily indicate onset of turbulence (see Part 2 of this series). Cairns and his co-workers apparently failed to collect any pressure-drop data that would allow calculation of the exact point where turbulence did commence. With the information at hand, we cannot tell how far in the turbulent region the Reynolds number of 30,000 mentioned above is, or whether it actually is in the turbulent region. Neither were any viscometric data taken for substantiating the assumption that the system behaved as a Newtonian fluid under laminar-flow conditions.

These studies were concerned with dilute solutions. It is a generally accepted fact that at low concentrations small solid particles are widely separated and often tend to settle fairly rapidly, but as the concen-

tration increases, the settling tendency usually disappears and the suspensions act like pastes.[8] Therefore, it may be suspected that Eqs. (41) to (46) should probably also be restricted to specific ranges of concentrations.

Any of these equations should be used with extreme caution for design work. It is to be hoped that future work on the settling of solids from slurries will be accompanied by pressure-drop data so flow diagrams can be constructed similar to those presented here (see below and p. 130) where the settling data can be included in the diagram.

Economic Pumping Velocities

For very fine slurries, the standard velocity may be within the range of economic pumping velocities, so there is no problem. However, with coarse industrial slurries such as pulverized coal or sand, the standard velocity may be far above the limit of economic pumping. Here, the slurry might be handled in the heterogeneous region, and experimental data must be taken in this region. With larger particles, it may be difficult or impractical to collect laminar data. But this is no great problem, since laminar flow would undoubtedly never be used with settling slurries. Turbulent data must be collected and Eqs. (43) to (46) used, to indicate various zones.

Regarding coarseness, there is one remarkable case recorded of a phosphate being pumped through a pipeline.[3] The lumps range up to 6 in. × 9 in. long. This is an exceptional case, however.

Pipe Roughness Is Tricky

Some words of caution should be injected here about pipe roughness. While laminar flow is not affected by it, turbulent flow is very much so. This is due mainly to enormously increased shear-stresses at the pipe wall in turbulent flow. Most non-Newtonian data have been collected in what may be called "smooth" pipes. The turbulent data of Alves, et al., were obtained in stainless steel tubes $\frac{1}{8}$ to $\frac{1}{4}$ in. in dia. Metzner and co-workers have used $\frac{1}{2}$-in. to 2-in. dia. smooth brass pipe.

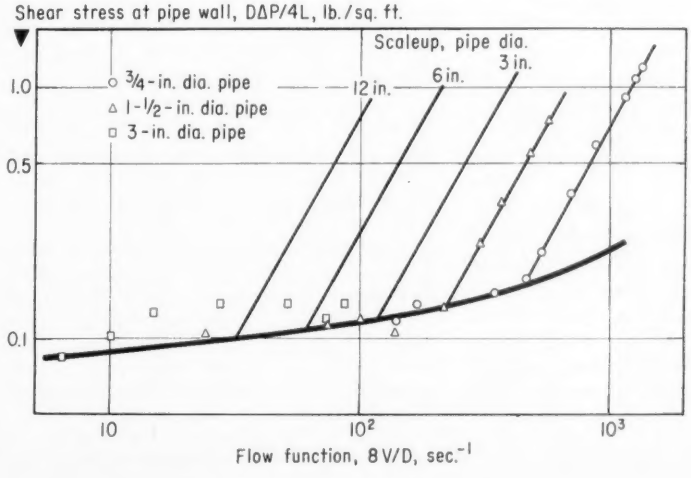
However, Caldwell and Babbitt used commercial black iron pipes with varying roughnesses.[9] They tested these with water and found that data for 1 and 2-in. pipes fell on lines corresponding to commercial black steel pipe. The 3-in. pipe was somewhat smoother, while the $\frac{1}{2}$-in. pipe was considerably rougher with correspondingly higher friction factors. It is important to note that the wide variety of fluids (sludges, slurries and suspensions) tested showed the same relative pipe roughness relationship as indicated on the Reynolds number correlation where the viscosity of water was used in the Reynolds number. We have shown that plastic viscosity could also have been used, but this would have only decreased all Reynolds numbers proportionally, so their qualitative correlation is correct.

For a given fluid and velocity, roughness in a pipe increases the pressure drop compared with conditions existing in a smooth pipe of the same diameter. This tends to flatten out the friction factor vs. Reynolds number curve, and decreases the slope b of the curve represented by Eq. (35) given in Part 4: Fanning friction factor $= a/(N_{Re})^b$. Decreasing b increases the slope c of the data when plotted according to Eq. (34):

$$D^{1+b}\Delta P/L = kV^{(a-b)} = kV^c$$

Therefore, we can say that, in general, slopes of the turbulent branches when plotted as $D\Delta P/4L$ vs. $8V/D$ or $\Delta p/L$ vs. Q will be greater for rough pipes than for smooth ones.

Unfortunately, the relative roughness for a class of pipes such as galvanized or wrought iron decreases with increasing pipe size. We can obtain a correlation for smooth pipes, but different sizes of rough pipes will not correlate. Rather, a separate curve for each one will be obtained on a friction factor vs. Reynolds



A 54.3% cement-rock suspension flow diagram has typical branch lines.

number chart. This means that while slopes of turbulent data for all sizes of smooth pipes will be the same, slopes for rough pipes will be different for every pipe size. For any accurate scaleup, the effect of roughness on each pipe size used on the pipe-flow chart must be considered.

How to Allow for Roughness

The data of Caldwell and Babbitt indicate that a good approximation can be obtained for non-Newtonian fluids by using the relative effect of roughness obtained for Newtonian systems.

Let's use the one published run of Caldwell and Babbitt for a 1-in. pipe to illustrate this point. The turbulent data on the $D\Delta P/4L$ vs. $8V/D$ plot indicate a slope of 1.84, while the friction factor vs. Reynolds number curve has a slope of −0.15. The fact that two slopes add up to 2.0 indicates the excellent precision of these data.

The authors point out that water data for this 1-in. pipe were very close to what would be expected for commercial black iron pipe. They have published a friction factor vs. Reynolds number chart for Newtonian fluids with pipe roughnesses as parameters. For Reynolds numbers up to 30,000, the lines are straight, with slopes of −0.24 for smooth pipes, −0.20 for a 1-in. black iron pipe, and −0.16 for a 1-in. galvanized iron pipe.[9] This means that the slopes of the turbulent branches on a $D\Delta P/4L$ vs. $8V/D$ plot of 1-in. data would change from 1.76 (smooth) to 1.80 (black iron) to 1.80 (galvanized). Thus, the slope of the smooth 1-in. pipe is about 98% of black iron, while the slope of the galvanized is 102% that of black iron pipe.

As an approximation, we can apply these ratios to the 1.84 slope for the 1-in. black iron data of Caldwell and Babbitt, so that we would have a slope of 1.80 for a smooth and 1.88 for a galvanized 1-in. pipe. We have no alternative but to assume that all of these lines pass through the same point on the laminar $D\Delta P/4L$ vs. $8V/D$ curve. So, at lower turbulent velocities there is very little error, while at higher velocities it becomes greater. This gives us a graphical representation of the effect of pipe roughness, which in this particular case is not very great (maximum 5%).

More-Recent Work

We have mentioned that the roughness Reynolds number chart of Caldwell and Babbitt showed the N_{Re} vs. f curves below a Reynolds number of 30,000 as straight lines. Above this point, some of the lines have lower slopes.

However, more-recent work has shown that these roughness correlatons are not straight lines, and at higher Reynolds numbers they tend to flatten to a zero slope.[10] A zero slope here means that the slope on the $D\Delta P/4L$ vs. $8V/D$ plot must equal 2.0. Thus, in the case of Newtonian turbulent flow, the turbulent branch for a particular rough pipe will have a slope that increases steadily until it reaches 2.0. However, there is no indication that this is the case for non-Newtonian fluids.

The best we can do is make an estimate as outlined above. Caldwell and Babbitt's data for plastic fluids seem to indicate that the friction factor vs. Reynolds number curves produce straight lines (their Newtonian data definitely curves). Obviously, further work is needed on the effect of pipe roughness in non-Newtonian systems. Any experimental work carried out for scaleup should include data taken with rough as well as smooth pipes. It has been suggested that "rifling" a pipe may actually decrease the head loss for slurries of large particles that otherwise would tend to settle.[1]

Nomenclature

A	Constant in Eq. (43).
C	Concentration of solid in a suspension, % by volume.
D	Pipe or tube diameter, ft.
g_c	Gravitational constant, 32.2 (ft./sec.)/sec.
k	Constant in turbulent correlation equations.
k_s	Constant in Eq. (41).
L	Pipe or tube length, ft.
ΔP	Pressure drop, lb./ sq.ft.
Δp	Pressure drop, psi.
Q	Flow rate, gpm.
V	Mean linear velocity, ft./sec.
V_f	Mean velocity at which a moving bed is formed with a settling suspension, ft./sec.
V_m	Mean velocity at which a stationary bed is formed with a settling suspension, ft./sec.
ρ_l	Liquid density, lb./cu.ft.
ρ_s	Solid density, lb./cu.ft.
ρ_o	$\rho_s - \rho_l$, lb./cu.ft.
ρ_m	Mean density of slurry or suspension, lb./cu.ft.
μ_l	Viscosity of liquid (Newtonian) suspending medium, lb./(sec.)(ft.).
μ_m	Viscosity of suspension, lb./(sec.)(ft.).
ζ	Mean particle diameter of solid in suspension, ft.

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Determining Equilibrium In Combustion Chambers

Computing equilibrium constants for high-temperature combustion reactions can be quite a task. Here's a simple graphical method that can supply the constant in minutes.

ROBERT L. PETERS, *Consultant, San Francisco*

If we know the correct equilibrium constants for a reaction in a high-temperature combustion chamber, we can go on to calculate the flame temperature, the most desirable combustion gas make-up, and the mole fraction of the products.

The equilibrium constant (K_p) varies with temperature, and calculating the constant by conventional methods involves some rather tedious repetitive calculations. The nomograph in this article provides a very simple graphical substitute for these calculations, and this can take some of the work out of general combustion chamber computations.

Calculating the Constant

Equilibrium is achieved when the products revert to reactants at the same rate as the reactants are converted into products. If we assume perfect gas properties, the equilibrium constant for this reversible reaction can be expressed as a function of the respective partial pressures:

$$K_p = \frac{(P_A)^a (P_B)^b (P_C)^c \dots}{(P_Z)^z (P_Y)^y (P_X)^x \dots}$$

where: A, B, C are reactants and a, b, c their respective number of moles. Z, Y, X are products and z, y, x their respective number of moles. P_n is the respective partial pressure.

Experiments have shown that the equilibrium constant is a function of temperature: $K_p = K_1 [f (K_2 + dT)]$. The constant can be obtained from the nomograph as shown below:

Example 1—What is the value of the equilibrium constant for the reaction $H_2O \rightarrow H_2 + \frac{1}{2} O_2$ at 5,000 F.?

1. From Table I, this corresponds to Code B.

2. Starting with 5,000 F. on the temperature line at the right, and selecting pivot point B, we index the line at the center with a straightedge. This point on the center index line is connected to lever point B by a straight line that intersects a K_p value of 0.049.

The value of K_p is a direct indication of the degree of dissociation. In the above example, the K_p value at 3,000 F. would only be 0.00018, while at 8,000 F., it would be 2.85. This of course indicates that such a temperature rise would increase dissociation very significantly.

Furthermore, if we consider the equation $H_2 \rightarrow 2H$, the nomograph shows that the K_p for this reaction at 5,000 F. is 0.028, while at 8,000 F., it is 100. This represents extreme monatomic dissociation, and thus illustrates that at high temperatures relatively complex molecules tend to break up into both simpler ones and also into monatomic constituents.

Flame Temperatures and Mole Fractions

To determine the constitution of the combustion gas, we must first determine the flame temperature. This may vary locally in the combustion chamber, but the general temperature range can be estimated by solving the formula:

$$Q = \Sigma \left(n \int_{T_0}^{T_C} C_p \, dT \right)$$

where $Q = \Delta h$, the heat of reaction of the products at reference temperature T_0, C_p is the average molar specific heat at constant pressure for the specific product gas in Btu./(lb. mole) (°F.), n is the number of moles of the gas, and T_C is the flame temperature.

The flame temperature affects K_p directly. The converse is also true because, by determining the heat change due to dissociation, K_p affects the flame temperature. Neither can be selected accurately in one step due to this interaction.

However, if we first assume some reasonable flame temperature, then determine the sundry K_p values that correspond to it, we can obtain a more-accurate value of the flame temperature, which will in turn yield a more-accurate value of K_p. This cyclic procedure can continue until the desired degree of accuracy is obtained.

Example 2—Consider a reaction taking place in the combustion chamber of a hydrogen-oxygen rocket engine. The weight flow of the liquid fuel is 200 lb./sec., the mixture ratio is 4 and the combustion takes place at 500 psig.

The possible reactions in the combustion chamber

are found in Table I under Codes B, C, E, F and G. Summarizing them in one equation,

$$n_{H_2}H_2+n_{O_2}O_2 \rightarrow n_{H_2O}H_2O+n_{H_2}H_2+n_{O_2}O_2+n_{OH}OH+n_OO+n_HH$$

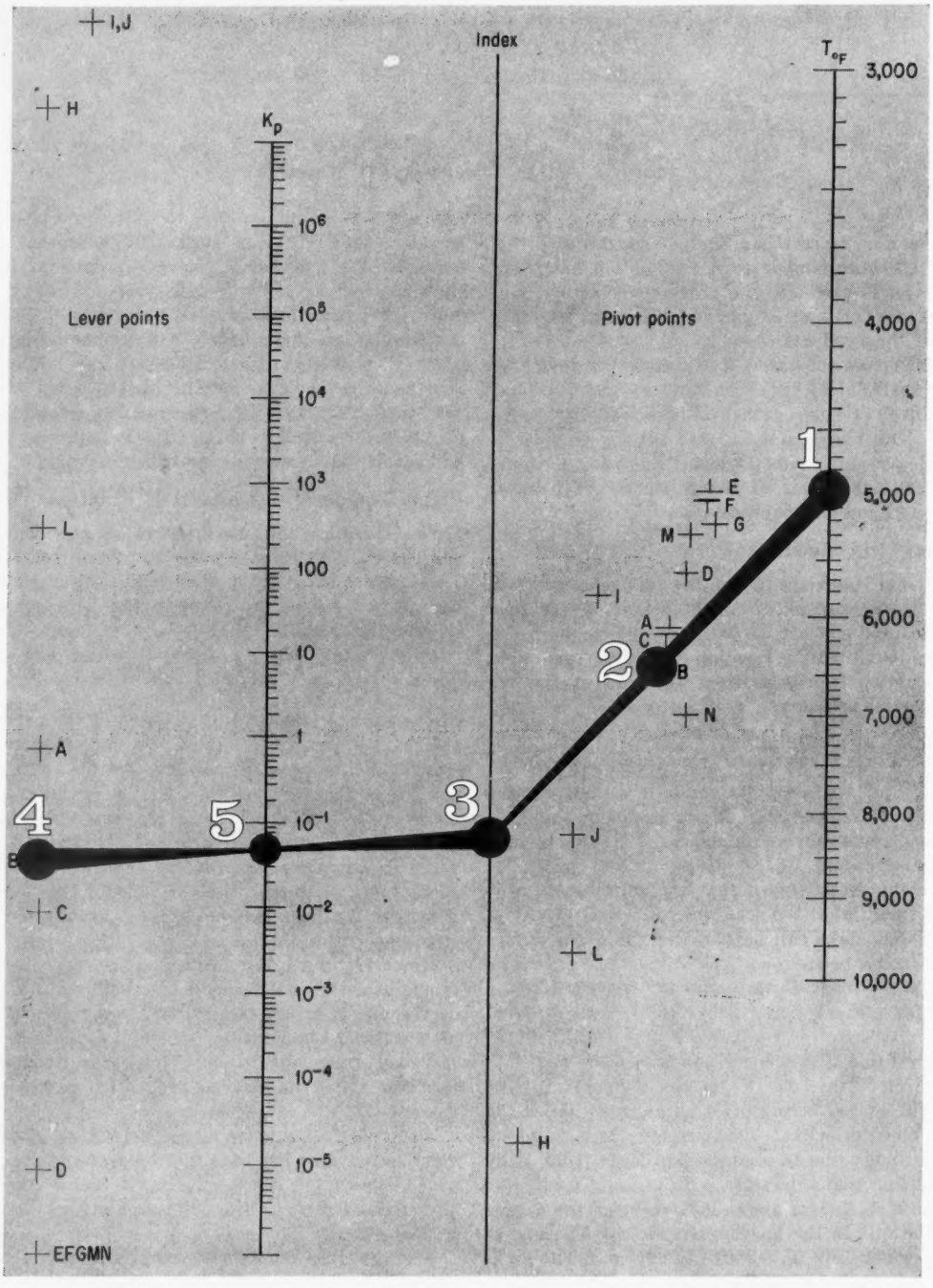
The weight flow of 200 lb./sec. at a mixture ratio of 4 corresponds to 40 lb. of hydrogen and 160 lb. of oxygen. Hence, for the left hand side of the above equation, $n_{o_2} = 160/32 = 5$, and $n_{H_2} = 40/2.01 = 19.92$. From this relationship, we may establish a mole-balance for each of the elements:

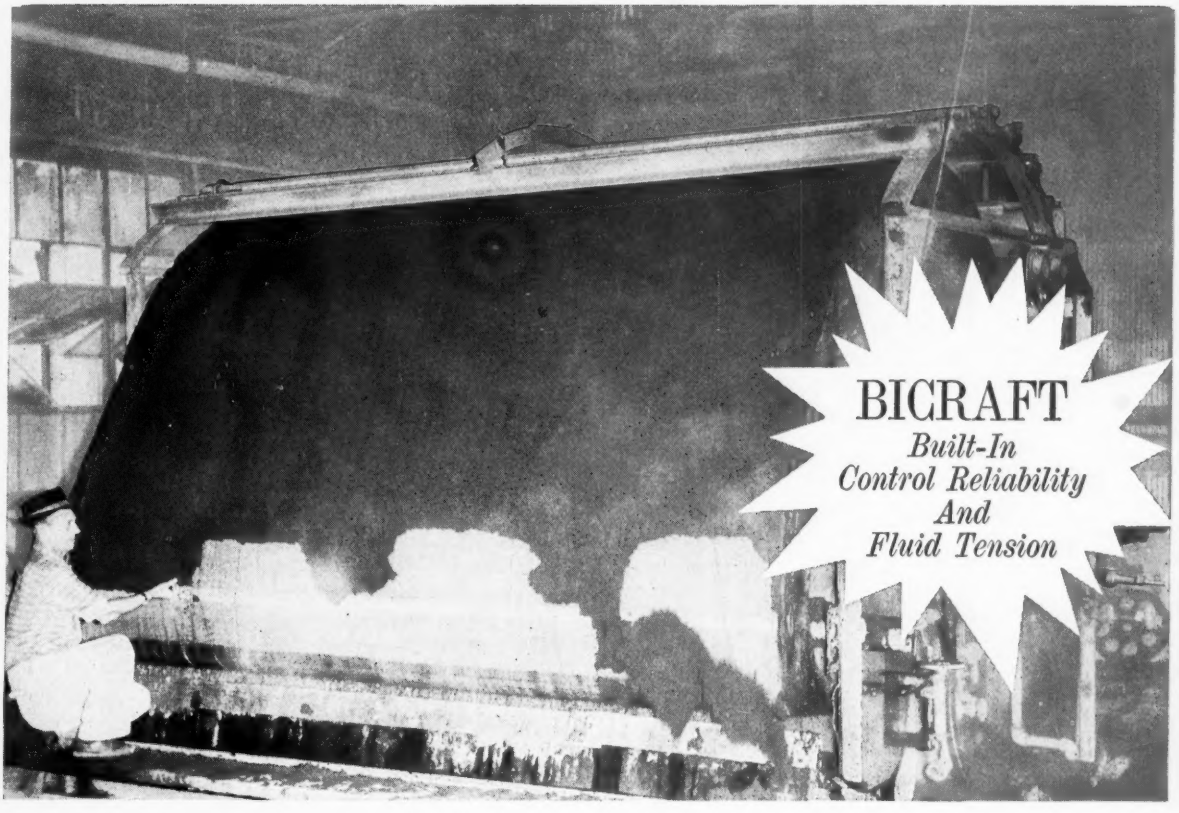
Oxygen: $2\ (5) \rightarrow n_{H_2O} + 2n_{O_2} + n_{OH} + n_O$

Hydrogen: $2\ (19.92) \rightarrow 2n_{H_2O} + 2n_{H_2} + n_H + n_{OH}$

The number of elements determines the number of

Equilibrium Constant (K_p) Nomograph





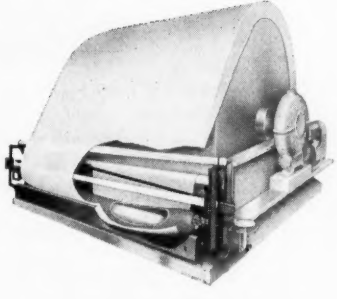
Break-Through in Cloth Discharge!

We have discovered a way to mount our Fluid Tension roller so that it automatically senses and corrects cloth misalignment without any instrumentation.

We call this amazingly simple tracking method

BICRAFT

(Built-In Control Reliability And Fluid Tension)



Also available in conversion assemblies for your existing filter units.

Feedback is Built-In and Controls on a Closed Loop principal . . . one of the most Reliable of automation principles. Its simple "continual correction of error" adds up to reliability in cloth tracking. The Fluid Tension roller continuously spreads and smooths the cloth . . . no powered helixes which wear the cloth are required. The cloth is always under uniform, gentle Fluid Tension to eliminate overstressed zippers and fabric. You don't have to worry about proximity switches or solenoid valves. There are no hems with cords or springs to wear out.

If you are considering belt type drum filters now or in the future, write us for more information on the BICRAFT system.

PETERSON FILTERS

AND ENGINEERING COMPANY

P. O. BOX 606 • 1949 SOUTH 2nd WEST STREET • SALT LAKE CITY 10, UTAH

Patented and Patents Pending.
Licensed from U. S. Borax and Chemical Company

Combustion Chamber Reactions—Table I

Code	Reaction	Equilibrium Equations
A	$CO_2 \rightarrow CO + \frac{1}{2}O_2$	$K_p = (n_{CO}\, n_{O2}^{1/2})\ (P/\Sigma n)^{1/2}/n_{CO2} = P_{CO}\ (P_{O2})^{1/2}/P_{CO2}$
B	$H_2O \rightarrow H_2 + \frac{1}{2}O_2$	$K_p = (n_{H2}\, n_{O2}^{1/2})\ (P/\Sigma n)^{1/2}/n_{H2O} = P_{H2}\ (P_{O2})^{1/2}/P_{H2O}$
C	$H_2O \rightarrow \frac{1}{2}H_2 + OH$	$K_p = (n_{H2}^{1/2}\, n_{OH})\ (P/\Sigma n)^{1/2}/n_{H2O} = (P_{H2})^{1/2}\ P_{OH}/P_{H2O}$
D	$H_2O + \frac{1}{2}N_2 \rightarrow NO + H_2$	$K_p = (n_{NO}\, n_{H2})\ (P/\Sigma n)^{1/2}/n_{H2O}\ (n_{N2})^{1/2} = P_{NO}\ P_{H2}/P_{H2O}\ (P_N)^{1/2}$
E	$H_2 \rightarrow 2H$	$K_p = (n_H)^2\ (P/\Sigma n)/n_{H2} = P_H{}^2/P_{H2}$
F	$O_2 \rightarrow 2O$	$K_p = (n_O)^2\ (P/\Sigma n)/n_{O2} = P_O{}^2/P_{O2}$
G	$H_2O \rightarrow H_2 + O$	$K_p = (n_{H2}\, n_O)\ (P/\Sigma n)/n_{H2O} = P_{H2}\ P_O/P_{H2O}$
H	$CO_2 + H_2 \rightarrow CO + H_2O$	$K_p = (n_{CO}\, n_{H2O})/(n_{CO2})\ (n_{H2}) = P_{CO}\ P_{H2O}/P_{CO2}\ P_{H2}$
I	$O_3 \rightarrow O_2 + O$	$K_p = (n_{O2}\, n_O)\ (P\Sigma n)/n_{O3} = P_{O2}\ P_O/P_{O3}$
J	$NO_2 \rightarrow NO + \frac{1}{2}O_2$	$K_p = (n_{NO}\, n_{O2}^{1/2})\ (P\Sigma n)^{1/2}/n_{NO2} = P_{NO}\ (P_{O2})^{1/2}/P_{NO2}$
L	$NO \rightarrow \frac{1}{2}O_2 + \frac{1}{2}N_2$	$K_p = (n_{O2}\, n_{N2})^{1/2}/n_{NO} = (P_{N2})^{1/2}\ (P_{O2})^{1/2}/P_{NO}$
M	$F_2 \rightarrow 2F$	$K_p = (n_F)^2\ (P/\Sigma n)/n_{F2} = P_F{}^2/P_{F2}$
N	$N_2 \rightarrow 2N$	$K_p = (n_N)^2\ (P/\Sigma n)/n_{N2} = P_N{}^2/P_{N2}$

Heats of Formation—Table II

	Btu./Lb.-Mole		Btu./Lb.-Mole
CO	47,500	NO	38,700
CO_2	169,000	NO_2	14,500
H	93,750	O	105,000
H_2	0	O_2	0
H_2O	104,000	O_3	61,000
N	153,000	OH	18,000
N_2	0		

weight balance equations we may write—in the above case, two.

Next, we assume a flame temperature. If we don't know too much about combustion conditions, we can choose a temperature at random in the 4,000-7,000 F. range (or in a higher range if a reason exists). For a preliminary estimate, we will use 5,000 F., (T_s).

The nomograph shows that K_p's for the possible reactions at this temperature are as follows:

$B = 0.049$ $E = 0.026$ $G = 0.008$
$C = 0.055$ $F = 0.018$

With these values, the mole fractions of the major constituents can be estimated. We can then determine the total heat of reaction from Table II. When we enter this value in the flame-temperature equation shown at the beginning of this section, we can solve for the upper limit temperature. This first approximation of the flame temperature, which we can call T_x, comes out to be 4,830 F.

If we want to continue the cycle, we enter this value in the formula:

$$T_N = (T_s^2 + T_x^2)^{1/2}/1.414$$

The value for T_N, which is 4,960 F. in our case, is then used instead of the original estimate of 5,000 F., to start the cycle. The value of T_x that eventually results will be closer to the true flame temperature than the 4,830 F. obtained previously.

While this cycle can be continued indefinitely, the approximations inherent in other parameters will soon become the limiting factor.

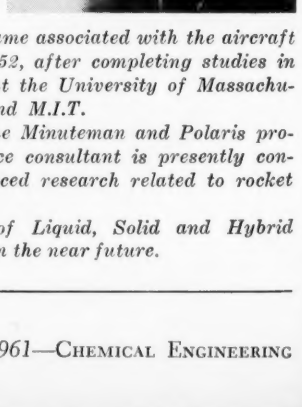
Incidentally, if the mixture ratio had been 8, the flame temperature would have approximated 5,800 F.

Once the flame temperature has been established accurately enough, final K_p's can be obtained from the nomograph. Simplification and solving of the reaction equations can then yield satisfactory estimates for the mole fractions of the major and minor constituents. From there, we can go on to calculate the total molecular weight and specific heat.

In some applications, the importance of local temperature variations within the combustion chamber must be evaluated. In rocket design, for instance, the effects of turbulence, diameter variations, heat transfer variables and discharge-nozzle temperature drops have to be considered.

Thus, the nomograph is only a starting point in many studies, but by simplifying general computations and cutting down the otherwise time-consuming repetitive calculations, it can be a very useful starting point.

Meet the Author



ROBERT L. PETERS *became associated with the aircraft and missile industry in 1952, after completing studies in mathematics and physics at the University of Massachusetts, Boston University and M.I.T.*

He has contributed to the Minuteman and Polaris programs, and as an aerospace consultant is presently conducting independent advanced research related to rocket design.

His textbook "Design of Liquid, Solid and Hybrid Rockets" will be published in the near future.

No. 55: Control and Relief Valves

First of a series on cost of process instrumentation elements takes up pneumatic control valves, steel and alloy relief valves.

BELA G. LIPTAK, *Instrumentation Engineer*
Crawford & Russell, Inc. Stamford, Conn.

With the trend toward more "automation," instrumentation becomes a major cost item in many new chemical plants.

In connection with a number of process design projects, I have collected some useful data on various aspects of process instrumentation. The curves presented here cover control and relief valves. Cost File in the future will take up panel instruments, transmitters, rupture disks, flowmeters.

▶ **Valve for Control**—Control valves are actuated by a signal from some automatic control device. A valve may operate by a pneumatic, hydraulic or electric signal, or a combination of these. The chart (Fig. 1) is based on pneumatic valves.

Costs include a 10% standard discount usually given contractors by valve manufacturers.

To use the curves, take the following steps:

- Select type of valve and valve size.
- Select material of construction.
- Get base price of valve.
- Add accessories to base price.

As an example, a 1½-in. flanged, carbon steel, globe valve will cost $220. If a positioner is required, add $100. A positioner is usually necessary on a spring actuator when static friction forces are large or response is slow. When piston-type operators are used, the positioner is part of standard construction. Add $110 for a side-mounted manual operator, $20 for a top-mounted travel stop.

▶ **Relief Valves**—Safety and relief valves are used to protect process equipment from damaging overpressures caused by fire, thermal expansion, etc.

Figs. 2 and 3 give costs of steel and alloy-steel valves. Costs are based on a 10% discount from list.

In using the charts, first choose a valve size and orifice opening. Valve sizes are designated by inlet and outlet diameters in inches; and by orifice area in sq. in., according to the following code:

D	0.110	E	0.196
F	0.307	G	0.503
H	0.785	J	1.287
K	1.84	L	2.853
M	3.60	N	4.34
P	6.38	Q	11.05
S, R	16.00	T	26.0

Thus, a 2J3 valve has a 2-in. inlet, a 3-in. outlet, and a 1.287-sq. in. orifice area.

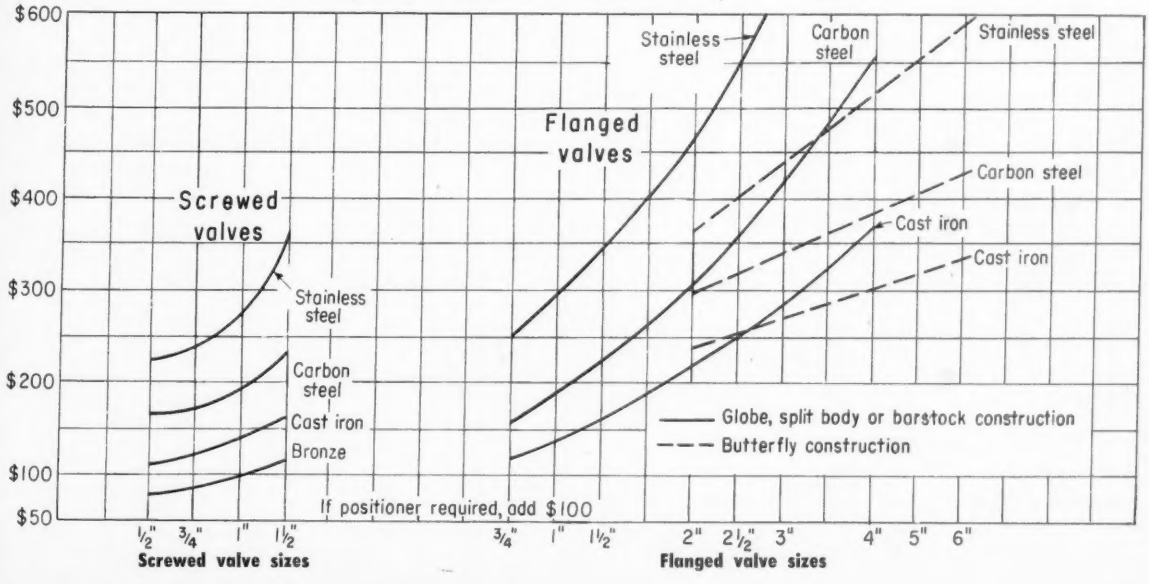
After selecting size, type of construction* and material, a base price can be taken off the curves. Then, correction factors can be applied for inlet flange rating, spring material and use of test levers.

Other charts are also based on a 10% discount, contain price information on small steel relief valves and cast iron and bronze valves.

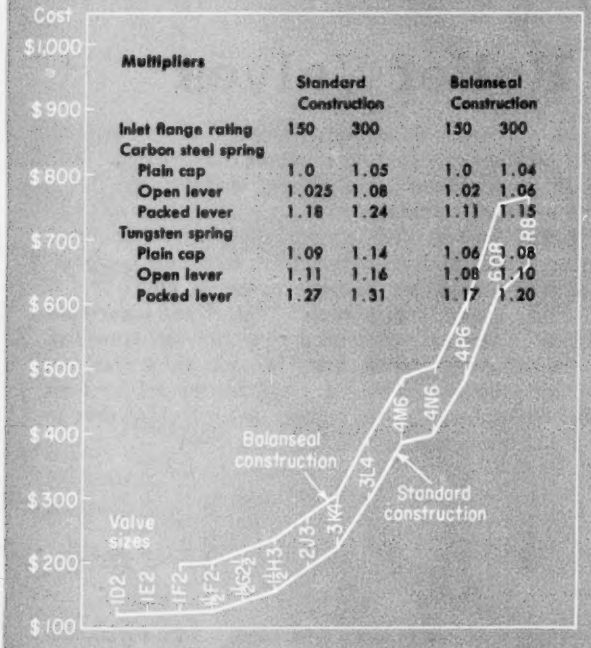
All costs refer to March 1961.

*Balanseal is a bellows that nullifies effect of back pressure and isolates internal working parts from the fluid.

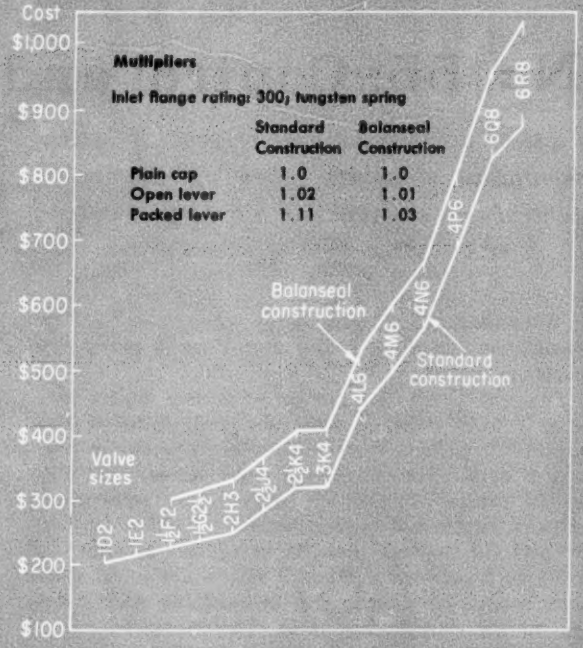
Diaphragm-operated control valves—Fig. 1



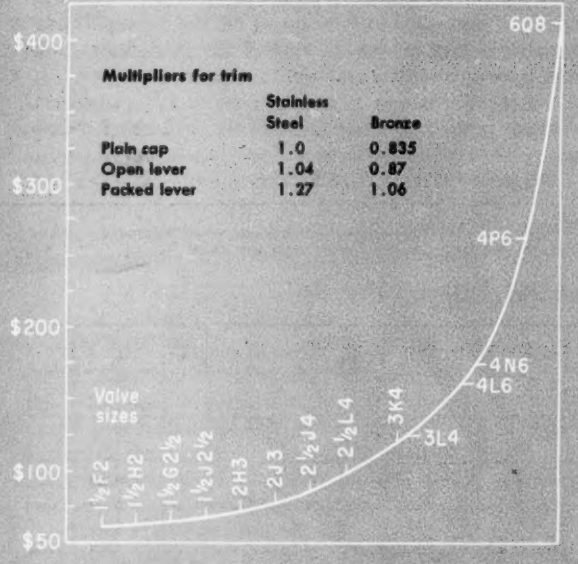
Carbon steel relief valves, flanged—Fig. 2



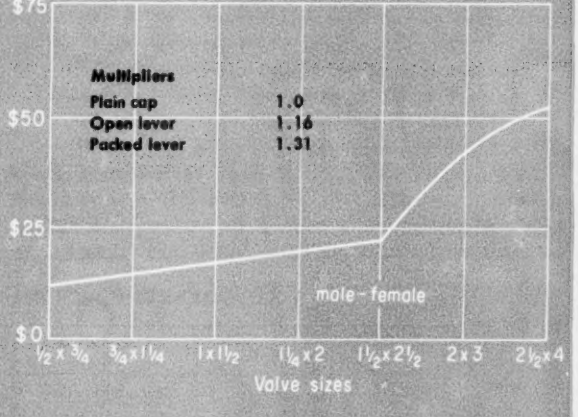
Alloy steel relief valves, flanged—Fig. 3



Cast iron relief valves, flanged—Fig. 4



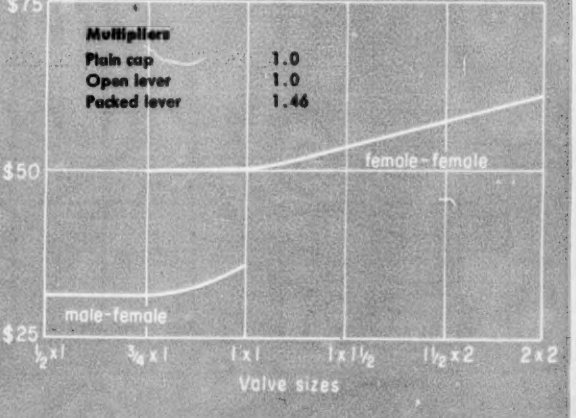
Bronze relief valves, screwed—Fig. 5



Barstock valves (fem.-fem.)

		Carbon Steel	Bronze	Stainless Type 303	Stainless Type 316
Plain cap	½ x ½	$38	$33	$52	$72
	¾ x ¾	$43	$38	$59	$82
	1 x 1	$67	$59	$92	$127
Test lever	½ x ½	$50	$46	$69	$85
	¾ x ¾	$57	$52	$78	$96
	1 x 1	$89	$82	$122	$150

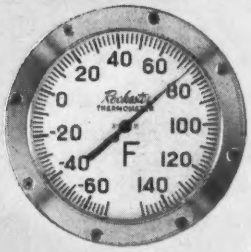
Steel relief valves, screwed—Fig. 6



BASIC in the Processing Industry

Process engineers searching for components to act as nerve centers for their products are sure to find the value of these American-Standard Controls Division products. This is true of anybody who must control or indicate the pressure or temperature of gases and fluids or electrical energy.

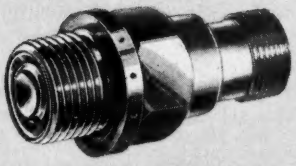
Industrial Thermometers



Rochester bimetal industrial dial thermometers provide extreme accuracy, are hermetically sealed and can be externally calibrated. Available in standard dial sizes from 1″ to 5″, and with scale ranges from minus 150°F to 1000°F.

AMERICAN-Standard
CONTROLS DIVISION

Norwood Transducers



Norwood bonded strain gage pressure transducers can be used wherever precision measurement of static and dynamic pressures are vital. They are virtually unaffected by extreme vibration or acceleration through the entire pressure range 0 to 60,000 psi. Models are available uncooled or for either air or water cooling. With air cooling gas temperatures as high as 2000°F can be safely applied. Water cooled models can measure gas pressures at temperatures to 5000°F; liquids to 1000°F.

AMERICAN-Standard
CONTROLS DIVISION

You can get detailed information on any of these products by writing American-Standard Controls Division, 5900 Trumbull, Detroit 8, Michigan.

Pressure, Temperature Controls

ASCD makes a wide variety of heavy duty controls for either pressure or temperature applications. They are extraordinarily rugged, can be designed to meet almost any condition.

AMERICAN-Standard
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AMERICAN-Standard
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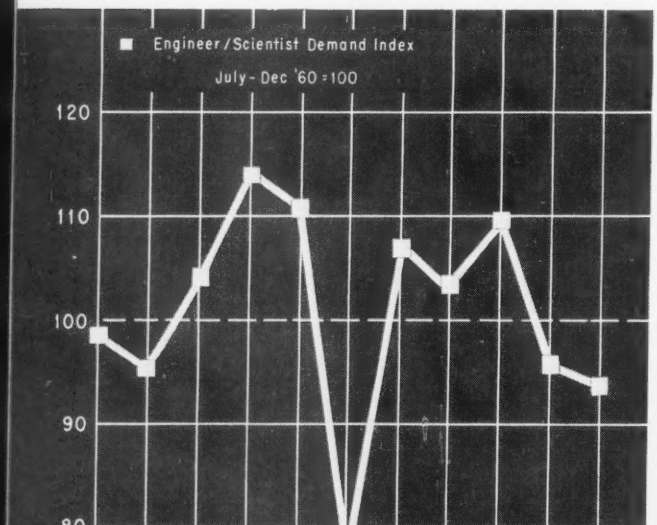
Does this new index of demand for engineers and scientists reflect the past year's job market?



Ups and Downs of The Job Market

	Composite Index	Technical Journal Sub-Index
July '60	98.5	98.8
Aug.	95.5	93.5
Sep.	104.2	106.1
Oct.	113.9	101.2
Nov.	111.0	102.2
Dec.	77.1	98.3
Jan. '61	107.0	104.2
Feb.	103.4	104.1
Mar.	109.8	122.9
Apr.	95.3	94.4
May	93.7	103.7

You might have been riding slopes of the adjacent hilly graph this past year. If so—if you were in the market for a new technical job—did you sense the ups and downs of the charted demand?

A New York advertising firm—Deutsch & Shea, Inc.—claims it may be able to do so by the use of an "engineer/scientist demand index." Plotted at left, the index has been issued monthly by the firm since last summer. Its current base period is July-December 1960.

Though by no means a new concept, an index that reflects "help-wanted" advertising data has never caught on generally among the various indicators that are found useful in forecasting. However, previous indexes have extracted advertising data for all manufacturing employment. The newer Deutsch & Shea index, if successful, may catch on in entirely different ways:

- Individual engineers and scientists may some day be able to gage their chances in the market to better time a job change.
- Recruiting firms, which develop needs for new engineers, may schedule their ad inserts to greater advantage.
- Advertising media—technical magazines and newspapers—may be able to predict their advertising volume with more confidence.

How the Index Is Constructed

To put its demand index together each month, Deutsch & Shea measures the number of recruiting ads and total lines or pages of space in technical journals and newspapers. (Display and classified ads are counted separately for the latter.) These publications (listed on p. 142) include four McGraw-Hill magazines—*Aviation Week, Electronics, Engineering News-Record* and *Nucleonics.*

In a "high-demand" month, October 1960, the 27 newspapers accounted for 6,366 classified ads running to 630,300 lines, and 702 display ads equivalent to 167,100 lines. Journals added 466 ads in 197.8 pages.

In a "low-demand" month, December 1960, newspapers added 5,032 classified and 336 display ads for a total of 458,700 lines. The technical magazines ran 440 ads in 194.2 pages.

These raw data are weighted to compensate for such variables as number of days in the month and number of issues in the month. A sub-index for each of the three major ad categories is then computed (see graph, p. 142). From the sub-indexes, the composite engineer/scientist demand index is derived.

Certain of the swings shown in the plotted com-

News from
National Carbon Company
Division of Union Carbide Corporation · 270 Park Avenue, New York 17, New York
In Canada: Union Carbide Canada Limited, Toronto 12

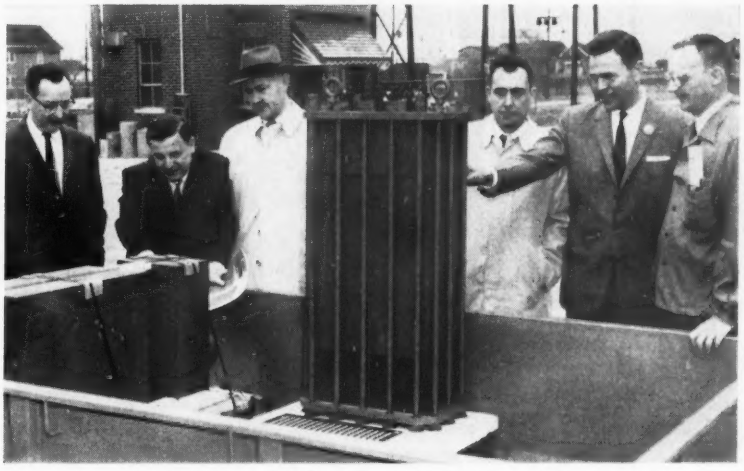
National Carbon representatives expand your engineering force

F. J. ANDERSON
Sales Engineer

Mr. Anderson joined the Carbon Products Sales department of National Carbon Company in November, 1951. Since 1952, he has represented the company in the Charleston, W. Va., Pittsburgh, and Houston territories, being active in Brush and Railroad Sales and more recently in Chemical Product Sales.

Mr. Anderson served in the Army Air Force 1943-1946, and was graduated from Fenn College with a B.S. degree in Chemical Engineering.

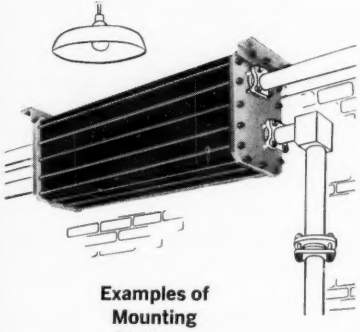
Chemical Processing Personnel See Construction Features of New "KARBATE" Heat Exchanger



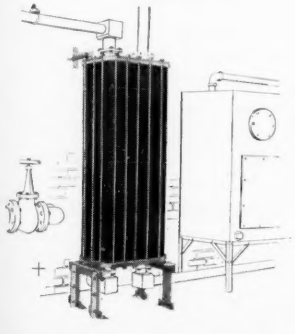
Personnel of Becco Chemical Division, Food Machinery and Chemical Corporation, Tonawanda, New York, being shown National Carbon Company's new "Karbate" impervious graphite heat exchanger Type CFB. Left-to-right in photo: H. G. Hyatt, Production Co-ordinator; J. F. Revilock, Manager, Process Equipment Sales, National Carbon Company; C. Keller, Assistant Purchasing Agent; J. Worrell, Plant Engineer; E. R. Hogan, Jr., Sales Engineer, National Carbon Company, Reid Garver, Engineering Development Supervisor.

Plant-site demonstrations of the new "Karbate" counterflow block heat exchanger are proving a helpful time-saver for chemical processing personnel concerned with the problems of corrosive heat transfer.

The trailer-mounted unit, demonstrated by NATIONAL CARBON's sales and service engineers, gives a close-up view of the construction of the CFB and expedites appraisal of its operating advantages.



Examples of Mounting Methods



"Karbate" Impervious Graphite Heat Exchanger Type CFB Provides Versatility in Mounting and Easy Installation

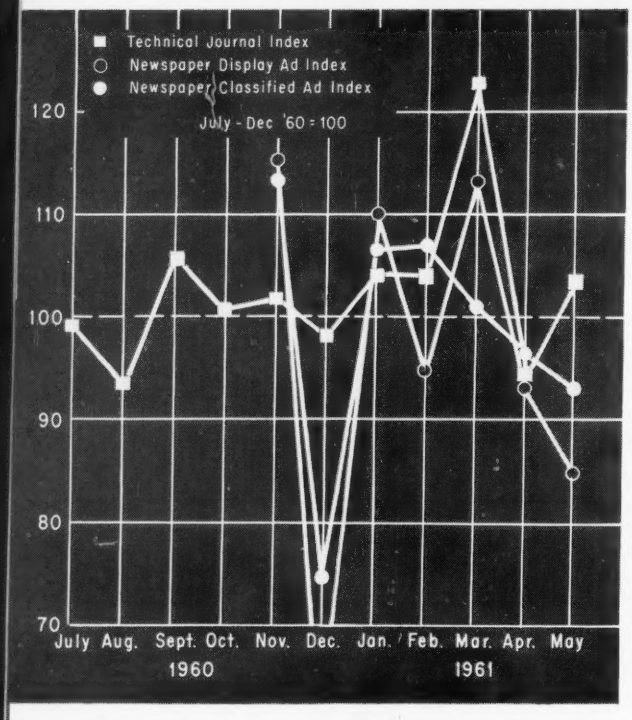
The Type CFB heat exchanger provides unsurpassed corrosion resistance and unique counterflow design. In addition, it can be installed vertically or horizontally, in a wide range of floor, wall, and ceiling positions. This advantage is particularly valuable where floor area, building construction, and proximity to other processing equipment put a premium on operating space.

The CFB measures only 13 inches by 21 inches in cross-section. When installed vertically it provides more heat transfer area per square foot of floor space than any other block type exchanger.

A variety of pass arrangements and a selection of heat transfer areas, ranging from 28 to 210 square feet, make it easy for the engineer to design the new "Karbate" Type CFB heat exchanger into his process system.

For detailed information on the features of this equipment, write for a copy of **Catalog Section S-6813.**

"National", "Union Carbide", "N" and Shield Device and "Karbate" are registered trade-marks for products of
NATIONAL CARBON COMPANY
UNION CARBIDE



Demand Index uses these publications

Astronautics	Mechanical Engineering
Aviation Week	Metals Review
Chemical & Engineering News	Nucleonics
Chemical Engineering Progress	Physics Today
Civil Engineering	Proceedings of the IRE
Engineering News-Record	SAE Journal
Electrical Engineering	Science
Electronics	Scientific American
Atlanta Constitution & Journal	Milwaukee Journal
Baltimore Sun	Minneapolis Star & Tribune
Boston Globe	New York Herald Tribune
Buffalo Courier-Express	New York Times
Cincinnati Post & Times-Star	Philadelphia Bulletin
Cleveland Plain Dealer	Pittsburgh Post-Gazette
Dallas Times Herald	Pittsburgh Press
Denver Post	San Francisco Examiner
Detroit Free Press	Seattle Post-Intelligencer
Detroit News	Seattle Times
Kansas City Star	St. Louis Globe-Democrat
Los Angeles Times	St. Louis Post-Dispatch
Miami Herald	Washington Post & Times Herald
	Washington Star

posite index are well known to recruiters and recruited. Each year, job offers and acceptances fall off in the holiday month of December. The composite index indicates this, but as the graph of the three sub-indexes shows, the drop is much greater in newspaper ads of both types.

After the holidays, though, the recruiting pace is faster, and the January 1961 index reflects it.

Too, engineers and scientists apparently defer new-job decisions until after vacations. The result is a slackened job market, which tightens up again in September. Big meetings, especially those attracting droves of recruiters and potential job-changers, tend to force advertising up, e.g., the March IRE show.

When it first set up the index, Deutsch & Shea studied the technical journal advertising of those magazines listed above for the first six months of 1960. The firm found that in the post-holiday recruiting rush of January and the IRE show month of March, ads averaged about a half-page each. In the other months of the first half of '60, ads averaged about 0.46 of a page each.

How the Indexer Sees the Index

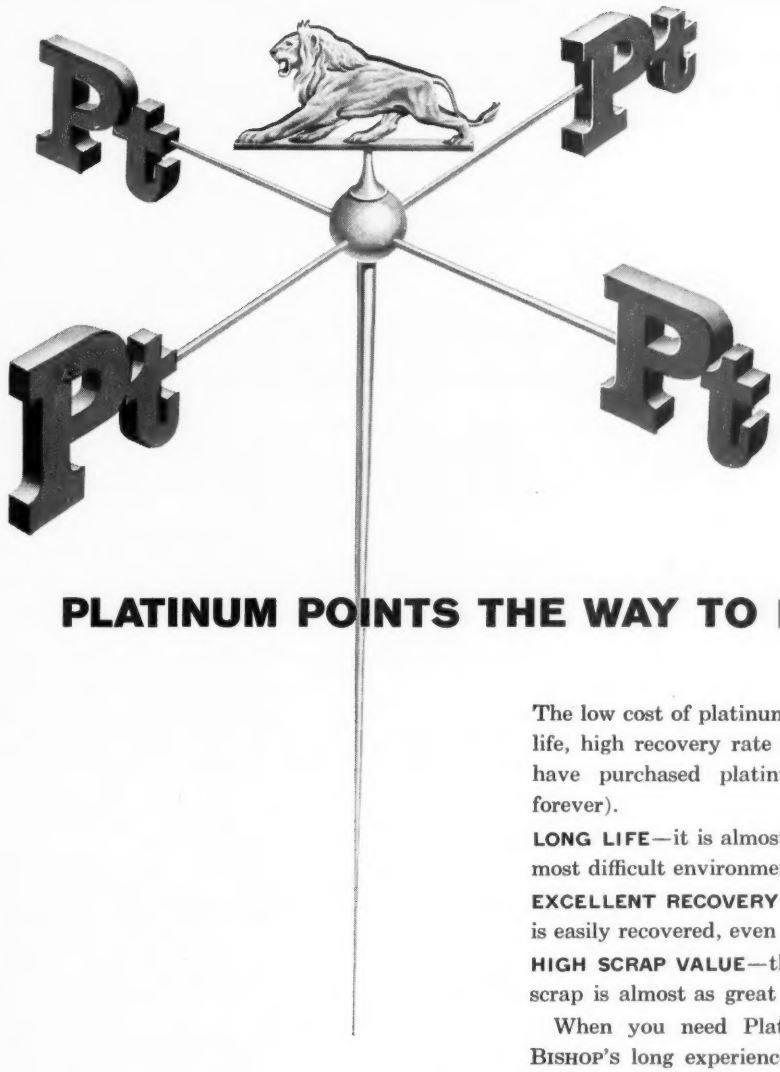
Though carefully warning that many aspects of its demand index require further study and explanation, Deutsch & Shea has attempted from time to time an explanation of index behavior. With respect to the March IRE show, for example, the firm discounts at least part of the effect of this huge meeting on increased advertising. It notes that electronics journals showed a jump from February, but that ads in magazines serving the chemical, aerospace and physics fields also registered gains.

You can examine the graph of sub-indexes shown above, compare it to the composite index charted on p. 140 to follow the explanation of some month-to-month changes. For example,

- The gain of October 1960 over September accrues from classified advertising. Journal advertising actually dropped. This may show that classified ads are the fastest form to herald new, immediate needs.
- The giant drop of December 1960 is mostly credited to newspaper ads that may be keyed to specific recruiting trips. Because of the lack of interest among technical men in changing jobs during December, the drop shows up where these trips are brought to public attention—in daily newspaper ads. Note that technical journal advertising dropped only slightly compared with that of newspapers.
- Discounting the post-holiday upsurge in recruiting activities, the figure for January 1961 actually indicates a downward trend from November 1960. This slump continued into February 1961, but was reversed in March.

Deutsch & Shea claims, by the way, that if you can accept the proposition that the demand for technical men serves as a leading indicator for the general economy, then the February figures showed that an upswing was probably still some months away for the economy as a whole. Others have found that help-wanted ads are more likely a coincident indicator, but Deutsch & Shea reasons that the lead time of new technical work requires engineers and scientists before effects of production are felt in the economy.

You might think about the engineer/scientist demand index. Maybe its graphical emphasis on seasonal factors alone will help you—next time you're in the job market.



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For the full story, write for Bulletin P-6.

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GOVERNMENT POLICY PAPER ASKS STEP-UP IN ENGINEERING EFFORT

Investing in scientific progress, claims National Science Foundation in a recent report with that title, may cost the United States in 1970 nearly three times what it will this year.

Showing that the nation's need for efforts of engineers and scientists can't be met by numbers alone, NSF says two things will help the U. S. meet its national scientific goal:

- Identification and development of latent talent.
- Utilization of developed talent.

(According to a recent Engineers Joint Council report, the U.S.S.R. graduated 108,000 diploma engineers in 1960, compared with 38,000 bachelor degrees in engineering in the U. S. last year.)

To arrive at its estimates of the support needed for education and research in 1970, the Foundation analyzed trends of the past 40 years and extrapolated them to 1970. Thus, it estimates a total labor force of 87-million in that year as compared to about 74 million in 1960. It also predicts a 6% per year growth rate in the number of scientists and engineers, a total of 2.5 million in 1970, and a growth of 7% per year in the number of doctorates in these fields to a total of 168,000 in 1970.

In looking at the expenditures necessary by all sectors of the economy, NSF says that $2.1 billion was spent in fiscal year 1961 for science and engineering education at college and graduate levels. Another $1.8 billion was spent on basic research. The total spent on all science and engineering education and all research is about $10 billion (less than 2% of the gross national product).

The report claims that looking ahead to 1970, the Federal Government will have to increase its proportion of financial support because of its leadership in ensuring the nation's well-being. What this means for central government spending is:

- $2.8 billion for buildings during the decade and $360 million during 1970.
- $200 million a year each year during the next decade, excluding high-energy accelerators and space vehicles.
- $5 billion for supporting costs of salaries, books, operating expenses, etc., in 1970. Of this, $2.2 billion will support basic research in the universities.

ANOTHER CHEMICAL ENGINEER-DIPLOMAT NAMED BY STATE DEPT.

Olaf Hougen, of the University of Wisconsin, will become the second chemical engineer to serve as science attache with a U. S. embassy.

Prof. Hougen, who just this year retired from the Wisconsin faculty, follows the lead that E. L. Piret, of the University of Minnesota, established in going to a similar State Department post in 1959 (*Chem. Eng.*, May 30, 1960, p. 107).

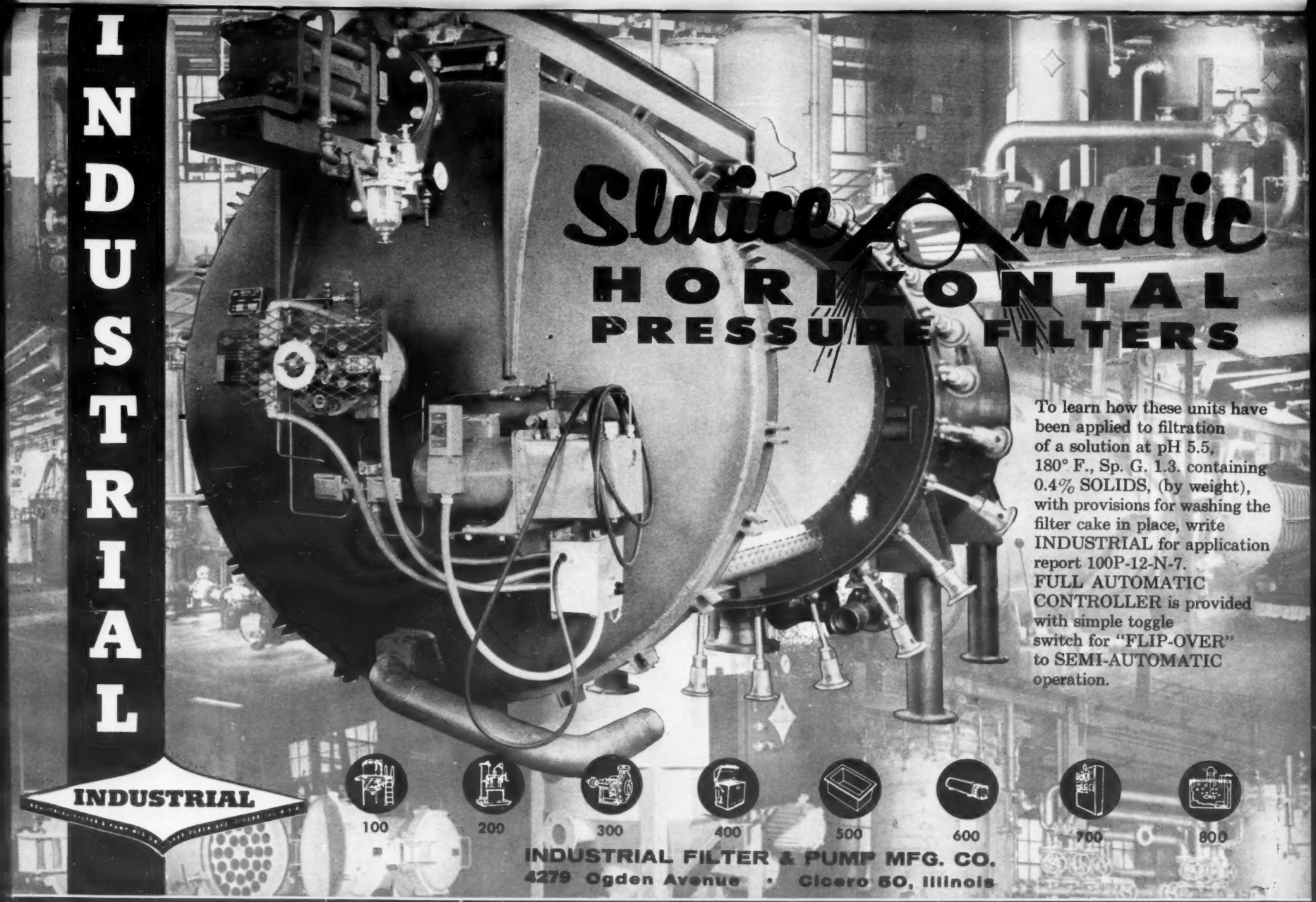
Hougen, whose professional honors include the AIChE Walker and Founders' Day awards, the ACS award in industrial and engineering chemistry and ASEE's Lamme gold medal, has been appointed to the advisory position in Stockholm for a two-year tour of duty. Of Norwegian descent, he will observe matters of scientific and engineering interest in all the Scandinavian countries from the Swedish post.

If Prof. Piret's duties are any criteria, Hougen will find himself a coordinator of efforts between U. S. and Scandinavian government research agencies, a peruser of the technical literature of those countries, an "eyes and ears" man for the Washington administration's science advisory groups, and an important on-the-spot advisor to our ambassadors.

No stranger to foreign affairs, Prof. Hougen served as Fulbright professor in chemical engineering in Norway in 1951 and in Japan in 1957.

Society of Women Engineers elevates ChE to presidency

At its 11th annual convention in Boston, the Society of Women Engineers elected chemical engineer Patricia L. Brown, of Texas Instruments Inc., to its presidency. Information services supervisor for her firm's semiconductor-components division, Miss Brown is a graduate of the University of Southwestern Louisiana, where she won a B.S.Ch.E. in chemical engineering, and the University of Texas where she received an M.A. in chemistry with a chemical engineering minor. At the Texas Instruments division, which she joined after working for Ethyl Corp. and Westinghouse, Miss Brown is responsible for library administration and guidance of material selection and cataloguing. The new SWE president is also a member of the American Chemical Society, the American Assn. for the Advancement of Science, and Special Libraries Assn.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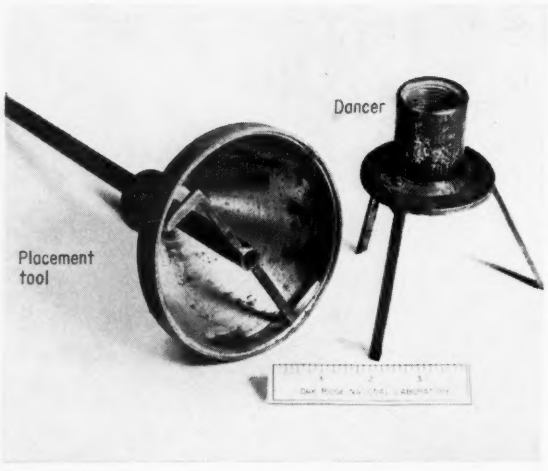
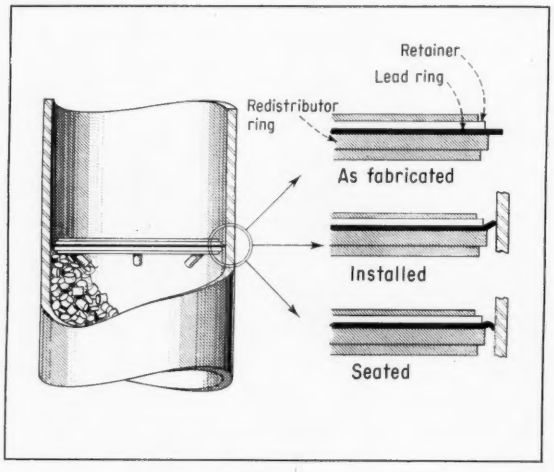




LEAD RING GIVES TIGHT SEAL IN PACKED COLUMNS

In applications where soft packings are not acceptable, this lead seal ring can be installed and seated with a dancer.

Winner of the June Contest*
B. B. KLIMA
Oak Ridge National Laboratory

Distillation in a series of packed columns in our laboratory required distribution of the liquid from the column walls back into the packing to obtain maximum efficiency. Redistributor rings to do this job are commercially available, but the asbestos or glass fiber packing supplied with them is incompatable with our process.

To overcome this problem, we designed a lead seal that allowed the rings to be installed deep in the columns with a tight seal.

The redistributor ring is machined to a diameter approximately $\frac{1}{32}$ in. smaller than the column, so that it will slide freely up and down. The lead seal ring is cut out approximately $\frac{1}{32}$ in. larger than the column diameter and is locked to the redistributor with a press-fit locking ring.

Two tools, a placement tool and a dancer, each with sectioned handles, are required to install the assembly in the column. The handles can be commercial aluminum pipe for light weight and ease of handling.

The packing is poured into the column, which is preferably flooded, to the desired depth and then compacted. The ring is locked into the placement tool and pushed down the column. Sections are added to the handle as required. As the ring passes down the column the lead ring turns up, as shown in the sketch above.

When the ring is resting on the packing, it is rotated to smooth the bed, the center lock is released and the tool is withdrawn. The dancer is now lowered into the column on top of the ring, with its feet resting on the lead seal.

Rotating the dancer while it is raised and lowered in short strokes forces the lead down flat so that it fills and seals the void between the ring and column wall. Usually, four complete rotations of the dancer give a tight seal, but a trial installation in a piece of pipe will develop the technique and train the operators.

This method of sealing redistributor and distributor rings in columns gives a leak-tight joint that can easily be inspected optically. The method is applicable to many types and sizes of packed columns, and possibly to other usages.

COMING SEPTEMBER 4
Fluorescent Bulb Makes Simple Turbidity Meter
By E. F. Symons, Midsummer Contest Winner

***How Readers Can Win**

$50 Prize for a Good Idea—Until further notice, the Editors of *Chemical Engineering* will award $50 each four weeks to the author of the best short article received during that period and accepted for publication in the Plant Notebook. Each period's winner will be announced in the second following issue and published in the fourth following.

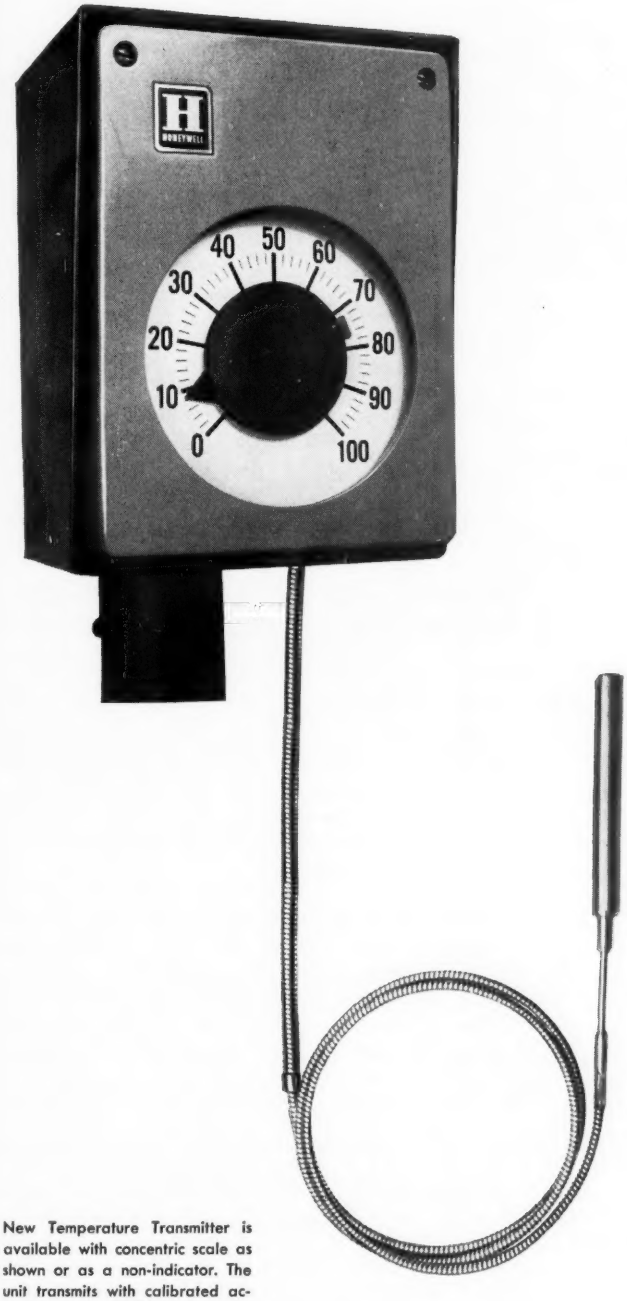
$100 Annual Prize—At the end of each year, the period winners will be rejudged by the editors and the year's best awarded an additional $100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at space rates ($10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant Notebook Editor, *Chemical Engineering*, 330 W. 42 St., New York 36.

NEW TEMPERATURE TRANSMITTER

offers thermal system options with ranges from −125° to 1000°F



New Temperature Transmitter is available with concentric scale as shown or as a non-indicator. The unit transmits with calibrated accuracy of ±0.5% of full scale, and indicates within ±1.0% of full scale.

Completely new, completely flexible, the new Honeywell Temperature Transmitter gives you a choice of either gas or mercury thermal system plus a wide selection of measuring bulb styles. Die-cast aluminum case is 4″ by 7″ by 9″. Concentric scale is 8½″ long.

New built-in rebalancing capsule automatically compensates for changes in ambient temperature. Two-way overload protection covers 100% of span. Maintenance is greatly simplified by modular construction which lets you remove any major component by loosening two screws. All field adjustments are easily accessible, and a self-locking feature prevents upset after calibration adjustments are made.

Transmitter Features: Gas (—125° to 800°F) and mercury (—40° to 1000°F) actuated thermal systems with bulbs for any application. Mount on pipe welded to flow line, or on bracket that clamps on the hex head of the socket. Vibration resistant thermal system means accurate measurement on vibrating flow lines.

For more complete details on the new Temperature Transmitter, call your nearby Honeywell field engineer. Or write for *S630-1*. MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa. In Canada, write Honeywell Controls, Ltd., Toronto 17, Ontario.

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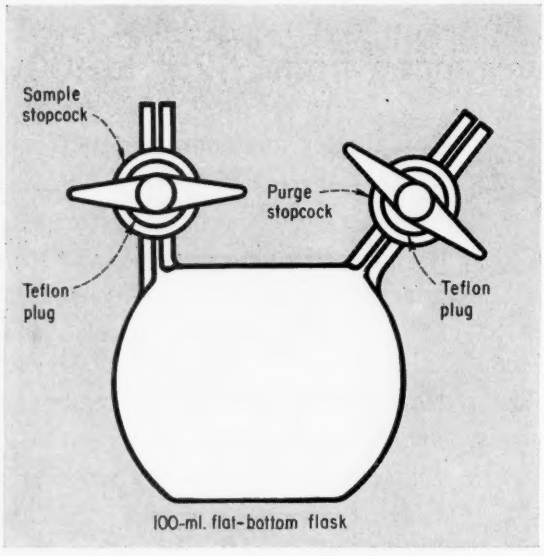


ELIMINATE CONTAMINATION OF ZIEGLER-CATALYST COMPONENTS

R. W. FORD and K. D. KISS
Dow Chemical of Canada, Sarnia, Ont.

The extreme sensitivity of Ziegler catalyst components, even after dilution, to traces of oxygen and water has been a problem associated with their use in the laboratory. We have designed the storage vessel shown in the sketch to overcome this problem.

Many workers have used dry boxes to handle these materials but this is, at best, a cumbersome procedure. A simpler method has been to use a stoppered bottle or flask, into the neck of which a nitrogen purge line is inserted whenever the container is opened. Although this method is convenient, it inevitably leads to contamination from the air or the stopper.

Our design consists essentially of a squat flat-bottom flask of about 100 ml. capacity with two Teflon-plug stopcocks attached to the top. The Teflon-plug stopcocks require no lubricant and hence eliminate one source of contamination.

A nitrogen purge, with a mineral-oil bubbler in parallel, is attached to the purge stopcock before it is opened. When a sample is to be taken, purge stopcock is opened, followed by the sample stopcock. This allows a flow of nitrogen to pass through the flask, and maintains a positive pressure in the flask, eliminating any chance of air contamination.

Sampling is accomplished by inserting the needle of a nitrogen-rinsed hypodermic syringe through the sample stopcock. When the syringe is removed, the stopcocks are closed in reverse order, thus maintaining the positive pressure at all times. We have found that catalyst solutions can be stored and sampled repeatedly in this way over an extended period of time with no apparent change in composition or properties.

The small flasks proved so useful that we have made larger ones, up to 1 liter capacity, in which we can dilute pure components. Some of these were modified by adding a standard-taper inner joint to the top of the flask, which is closed by a matching cap. This simplifies addition of the pure aluminum alkyls, which can be dispensed into the flask directly from the cylinders in which they are received, under a constant nitrogen purge. Syringes fitted with long needles are used to transfer solutions.

Although we designed these vessels for Ziegler catalyst components, they can also be used for any air- or water-sensitive liquids.

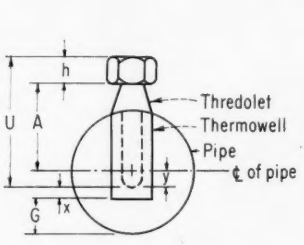


Fig. 1
For bare pipe

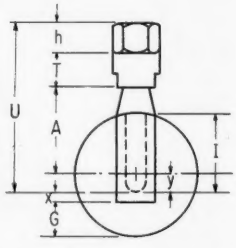


Fig. 2
For insulated pipe

CHARTS AND TABLES SPEED UP THERMOWELL SPECIFICATIONS

MOHAMMAD BASHAR
H. K. Ferguson Co., San Francisco, Calif.

A tedious task for the design engineer is the specification of thermowells for a large number of thermometers or thermocouples in different pipe sizes. I have calculated the essential dimensions for these thermowells, and present the calculations here in tabular and graphical form.

Figs. 1 and 2 illustrate the pertinent dimensions. The immersion depth I must be such that the measuring element is far enough into the fluid to give a representative reading. Dimensions have been chosen to make I as close to 2 in. as possible. Dimension G, the clearance between the bottom of the well and the opposite pipe wall, must be great enough to avoid damage to the well or pipe.

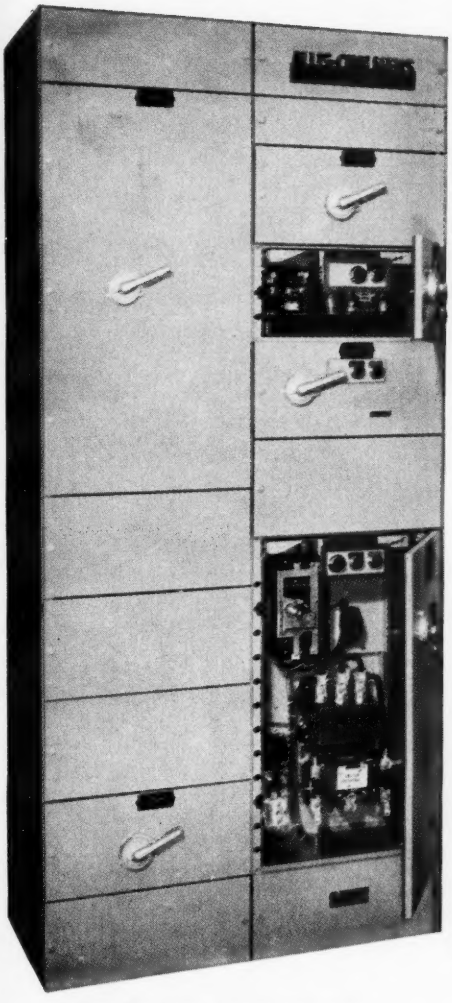
My calculations are based on the use of $\frac{3}{4}$-in. Thred-

TEST YOUR CEQ

ROBERT LEMLICH

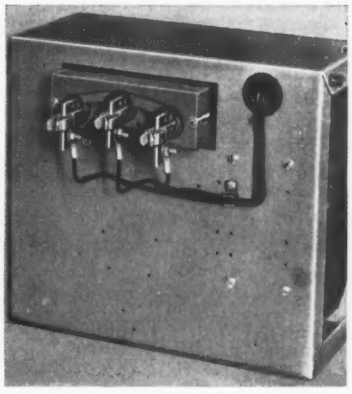
A certain small overseas petroleum company plans to sell, at par, oil revenue bonds paying 10% interest per annum. Furthermore, in an effort to make these bonds more attractive to investors, the interest will be compounded instantaneously instead of semiannually. Does the plan seem plausible? *Answer on page 152*

ALLIS-CHALMERS

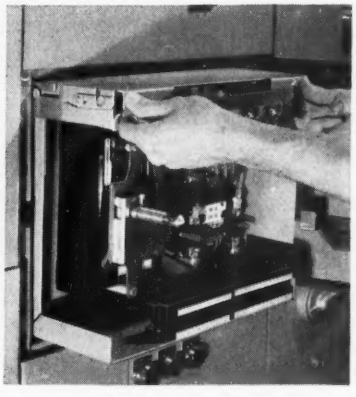


1. Centralized control saves space, cuts installation and engineering costs.

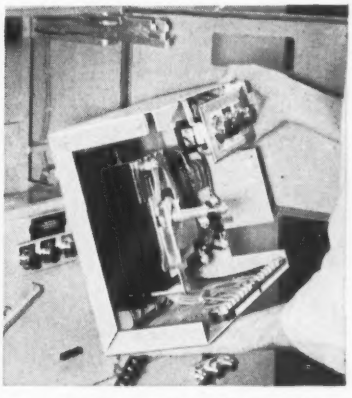
2. Exclusive plug-in terminal blocks permit removal of units without tools. Fully accessible location at front of units simplifies your wiring.



3. Extra heavy plug-in stabs and positive alignment provided by TRACK-GUIDE drawout mechanism assure trouble-free electrical connection.



4. With TRACK-GUIDE mechanism, units can be easily and safely de-energized and locked out, or withdrawn from enclosure for inspection and maintenance.



5. Units can be tilted up for inspection of stabs without removing from TRACK-GUIDE mechanism, or fully removed for bench maintenance or interchange.

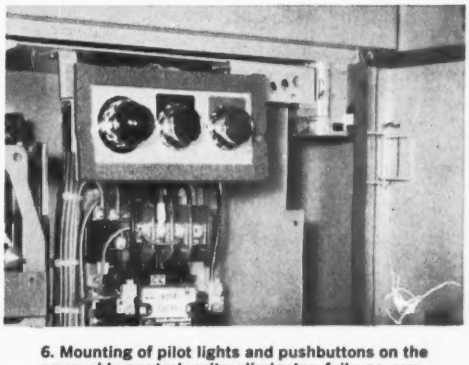
...six reasons why Allis-Chalmers new motor control center design is

the center of satisfaction

Satisfaction? It comes with every one of the new (yet fully proven) low-voltage control centers from A-C. Their clean lean design saves valuable space. Exclusive plug-in terminal blocks cut installation time . . . speed inspection and removal. *Track-Guide* drawout mechanism lowers maintenance costs. Control units can be drawn out, tilted up, or completely removed without tools.

Safety features of these new control centers provide *sure* protection to personnel. Units can be quickly de-energized for maintenance or inspection work. Units cannot accidentally fall out of *Track-Guide* mechanism during inspection or maintenance.

Reliability . . . versatility . . . economy . . . strength . . . safety. You name the feature — A-C motor control centers have it. *Ask your A-C representative or distributor for all the facts. Or write* **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wis.*



6. Mounting of pilot lights and pushbuttons on the removable control units eliminates failures common with hinged wiring.

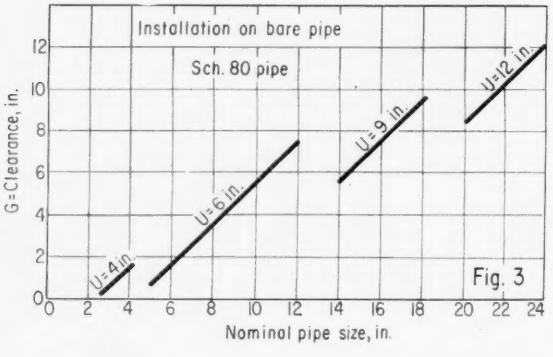
Track-Guide is an Allis-Chalmers trademark. A-1486

olets on Sch. 80 pipe—the worst possible case. The values are obtained from standard pipe and Thredolet dimensions. For any assumed value of U, dimension A is obtained from the Thredolet catalog and the other dimensions are calculated as follows:

1. $(A + h)$ is smaller than U.
   $y = U - (A + h)$
   $G = \frac{1}{2} I.D. - (y + x)$
   $I = I.D. - (G + x)$
2. $(A + h)$ is greater than U.
   $y = (A + h) - U$
   $G = \frac{1}{2} I.D. + (y - x)$, if y is greater than x, or
   $G = \frac{1}{2} I.D. - (x - y)$, if x is greater than y.
   $I = I.D. - (G + x)$

In both cases, $h = \frac{3}{4}$ in. and $x = \frac{1}{4}$ in. Results are shown in the two tables and the graphs.

Fig. 3 is used to obtain directly the dimensions for installation on bare pipes if a $\frac{3}{4}$-in. Thredolet is used. For other sizes, take dimension A from the catalog and calculate the other dimensions as above.



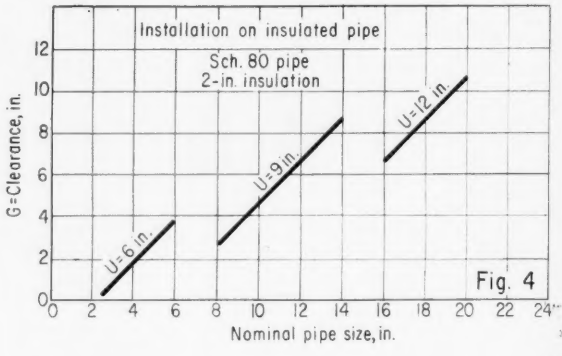
Dimensions for direct installation on bare pipe—Table I

Pipe Size (Sch. 80)	Pipe I.D.	U	A	G	I
2½	2.323	4	2.547	0.21	1.86
3	2.90	4	2.86	0.81	1.84
3½	3.364	4	3.109	1.29	1.824
4	3.826	4	3.36	1.77	1.806
5	4.813	4	3.89	2.796	1.767*
4	3.826	6	3.36	−0.23*	.....
5	4.813	6	3.89	0.796	.3.76
6	5.761	6	4.423	1.803	3.71
8	7.625	6	5.423	3.73	3.64
10	9.564	6	6.485	5.755	3.56
12	11.376	6	7.485	7.665	3.46
14	12.50	6	8.109	8.859†	3.39
14	12.50	9	8.109	5.859	6.39
16	14.314	9	9.109	7.76	6.30
18	16.126	9	10.109	9.67	6.21
20	17.938	9	11.109	11.57†	6.11
20	17.938	12	11.109	8.58	9.109
24	21.564	12	13.109	12.38	8.934

All dimensions are inches.
* Not enough immersion or stem too far down. Don't use this stem length for this pipe size.
† Bottom of thermo element exceeding 2 in. above center line of pipe. Don't use this stem length for this pipe size.

Fig. 4 is similarly useful for $\frac{3}{4}$-in. Thredolets and 2-in. thick insulation on the pipes.

For pipes smaller than 2 in., the wells must be installed in elbows or some other fitting.



Dimensions for direct installation on insulated pipe—Table II

Pipe Size (Sch. 80)	Pipe I.D.	U	A	G	I
2	1.939	6	2.297	−0.234*	.....
2½	2.323	6	2.547	0.21	1.86
3	2.9	6	2.86	0.81	1.84
3½	3.364	6	3.109	1.29	1.82
4	3.826	6	3.36	1.77	1.806
6	5.761	6	4.423	3.80	1.711
8	7.625	6	5.423	5.73*	1.64
8	7.625	9	5.423	2.735	4.64
10	9.564	9	6.485	4.767	4.547
12	11.376	9	7.485	6.673	4.453
14	12.50	9	8.109	7.859	4.39
16	14.314	9	9.109	9.766†	4.29
16	14.314	12	9.109	6.766	7.298
18	16.126	12	10.109	8.672	7.204
20	17.938	12	11.109	10.578	7.111
24	21.564	12	13.109	14.391†	6.923

DOUBLE POLYETHYLENE DRUMS FOR SIMPLE CALIBRATION TANK

LESLIE SILVERMAN
Harvard University, Boston, Mass.

For the past two years, we have been using a simple static chamber for calibration of gas detectors and explosion meters.

As shown by the sketch, the chamber is constructed of two polyethylene chemical drums, 55 gal. capacity, giving a total volume of 416 liters. For mixing the gases, a small axial fan, similar to those used to cool radar sets, and a shaded pole motor are provided. The nonsparking motor is placed inside the chamber and its cord is connected to the outside through a gas-tight seal using a plastic stopper and cement. Sampling ports are easily placed in the drum walls.

The equipment is light enough (less than 25 lb.) to

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Latest in this series is new Enjay hexyl alcohol. Of particular interest to vinyl plastic compounders are the phthalate esters of hexyl alcohol. Their good solvating properties make them highly efficient as calendering aids. Hexyl alcohol has other important applications as a raw material for flotation agents, lubricant additives, degreasing fluids, brake fluids and agricultural chemicals. For specifications on the full line of Enjay alcohols, or other high quality chemicals, write to Enjay, 15 W. 51st Street, New York 19, N. Y.

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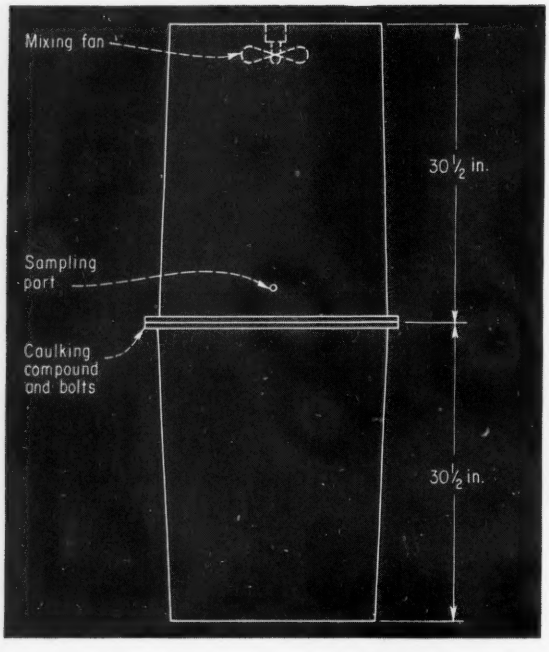

be carried by one man and can be used for demonstrations in front of safety groups and other plant personnel.

We have successfully used the chamber for a number of gases including carbon dioxide, carbon monoxide, propane, sulfur dioxide, hydrogen sulfide, ozone and oxides of nitrogen. Organic solvents, such as methyl methacrylate monomer, carbon tetrachloride and trichloroethylene, have also been used successfully in the chamber.

With some other organic solvents, we have experienced a slight wall loss, although it takes a considerable period of time before this loss becomes significant. Concentrations of the gases listed above, however, can stand for several hours without any significant loss.

The gas mixtures are made by injecting known amounts of pure or assayed gases with a calibrated glass syringe or by injecting solvents with a liquid micro syringe.

EMPIRICAL EQUATION FOR NON-NEWTONIAN SYSTEMS

NING HSING CHEN
Aerojet General Corp., Sacramento, Calif.

For turbulent flow of non-Newtonian fluids through smooth, round tubes, D. W. Dodge and A. B. Metzner presented for the first time an excellent article in which a theoretical analysis based on the power-law rheological model had been made, and the functions of flow behavior index in the theoretical derivation were determined from experiments (*AIChE Journal*, 5, 189, 1959).

The final equation (plotted in their Fig. 12) is

$$\sqrt{\frac{1}{f}} = \frac{4.0}{(n')^{0.75}} \log_{10} [N_{ReM} (f)^{1-(n'/2)}] - \frac{0.40}{(n')^{1.2}} \qquad (1)^*$$

Although Eq. (1) correlates 69 experimental points with an absolute average deviation of 1.9%, the solution for the friction factor f is by trial and error. For this reason, Dodge and Metzner have also presented in the same article a Blasius-type equation as

$$f = a_n/(N_{ReM})^{b_n} \qquad (2)$$

where a_n and b_n were plotted as a function of n' in their Figs. (17) and (16), respectively. However, these two functions can be reduced to the following equations:

$$a_n = 0.0165 \log_{10} n' + 0.0778 - [6.72 \times 10^{-5}/(n')^2] \qquad (3)$$

$$b_n = 0.251/(n')^{0.2158} \qquad (4)$$

(Continued on page 154)

* This is Eq. (27) in *Chemical Engineering's* comprehensive seven-part review of non-Newtonian flow, see July 10 issue, p. 148.

Answer to Test Your CEQ

By the familiar compound interest formula, one dollar at annual interst i compounded p times per year accumulates to $(1 + i/p)^{np}$ dollars at the end of n years.

By setting $n = 1$, we can compare the relative costs at the end of one year for different p at fixed i. For example, for annual compounding we have

$$(1 + i/p)^p = 1 + 0.10 = 1.10$$

or a cost of 0.10. For semiannual compounding we have

$$(1 + 0.10/2)^2 = 1.1025$$

or a cost of 0.1025. For instantaneous compounding, we let p approach infinity. Then, expanding by the binomial theorem and simplifying

$$\lim_{p \to \infty} (1 + i/p)^p = 1 + i + \frac{i^2}{2!} + \frac{i^3}{3!} + \ldots \qquad (1)$$

Alternatively, we can simplify

$$\lim_{p \to \infty} (1 + i/p)^p = e^i \qquad (2)$$

Substituting $i = 0.10$ in Eq (1), which then rapidly converges, or simply substituting in Eq. (2), yields the following:

$$\lim_{p \to \infty} (1 + 0.1/p)^p = 1.1052 \qquad (3)$$

Thus the cost for instantaneous compounding is 0.1052. This is only slightly higher than the cost for semiannual compounding. Accordingly, we conclude that the plan is plausible.

Note that specifying compounding of the interest implies some type of accumulation bond. This is necessary because the company could hardly mail out a batch of infinitesimal interest checks every instant of time!

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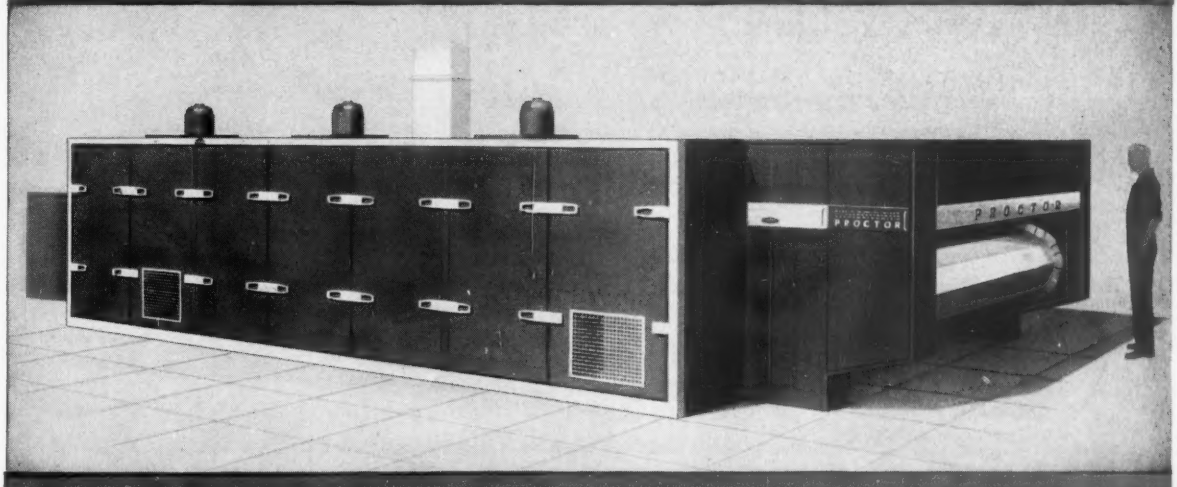

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Then Eq. (2) can be expressed explicitly in f as

$$f = \frac{0.0165 \log_{10} n' + 0.0778 - [6.72 \times 10^{-5}/(n')^2]}{(N_{ReM})^{\beta}} \quad (5)$$

where $\beta = 0.251/(n')^{0.2158}$

Eq. (5) was compared with Dodge and Metzner's Fig. (12), which is a plot of Eq. (1). For 132 selected points the average deviation of values obtained by Eq. (5) from values obtained by Fig. (12) is − 0.85%, and the standard deviation is ± 2.60%. At most values of n', the deviation tends to be larger than standard at high and low N_{Re}.

Nomenclature

a_n, b_n	Dimensionless functions of flow-behavior index for Blasius-type equation.
D	Internal diameter of pipe or tube.
f	Fanning friction factor.
K'	Fluid consistency index, $(D\Delta P/4L) / (8V/D)^{n'}$.
L	Length of pipe or tube.
n'	Flow-behavior index, dimensionless $= d \log (D\Delta P/4L)/d \log (8V/D)$
N_{ReM}	Generalized Reynolds number, dimensionless $= D^{n'} V^{2-n'}\rho/g_c K' 8^{n'-1}$
ΔP	Pressure drop.
V	Mean linear velocity.
ρ	Density.

STEAM FLOW THROUGH ORIFICES

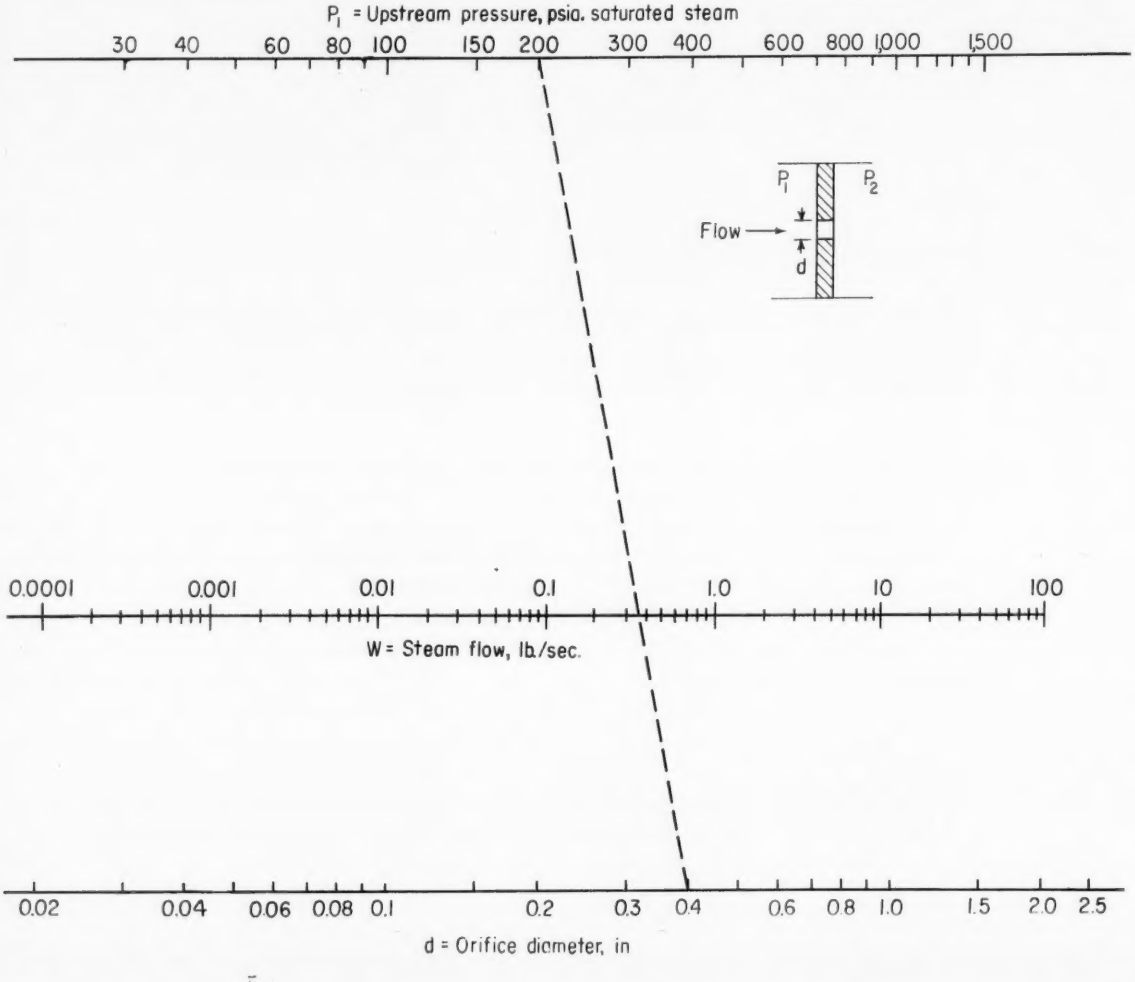
EDWARD J. GIBBONS

Colgate-Palmolive Co., Jersey City, N. J.

This is the first in a series of chemical-engineering design charts and tables that Mr. Gibbons has prepared for his work over a period of years. The charts will be a regular feature of Plant Notebook.—ED.

This nomograph is used to calculate the flow of saturated steam through an orifice. The answer obtained is the theoretical value when P_2 is less than 58% of P_1. For the actual value, multiply flow W by the coefficient of discharge for the orifice.

For wet steam, divide the answer by the square root of the quality at inlet conditions. For superheat, divide the answer by $(1 + 0.00065t)$, where t is the degree of superheat in the steam at inlet conditions.



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Here's how to get less-than-tankcar, or less-than-truckload drum quantities of acrylate and methacrylate monomers at tankcar or carload prices.

1. Plan your purchases so that the total quantity of monomers or auxiliaries adds up to a full car or truck weight.
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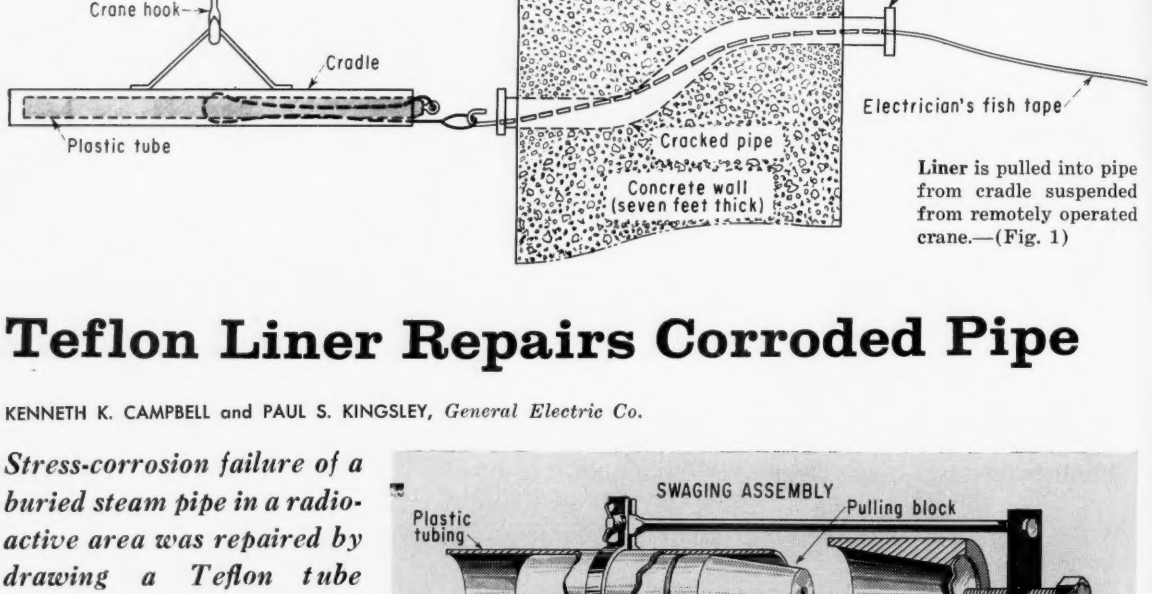


Liner is pulled into pipe from cradle suspended from remotely operated crane.—(Fig. 1)

Teflon Liner Repairs Corroded Pipe

KENNETH K. CAMPBELL and PAUL S. KINGSLEY, *General Electric Co.*

Stress-corrosion failure of a buried steam pipe in a radioactive area was repaired by drawing a Teflon tube through the cracked pipe.

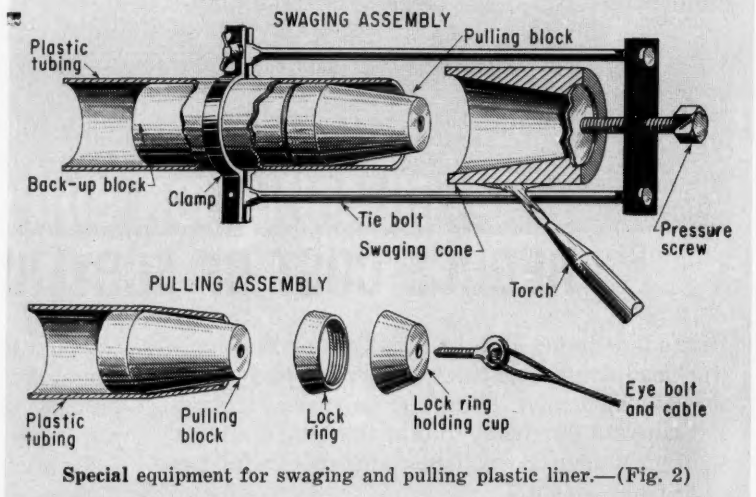
When cracks appear in a steam pipe embedded in concrete, pipe repair is likely to be difficult. A Teflon-compound liner, pulled through the pipe, solved such a problem, even though repair was complicated by high radioactivity at one end of the pipe.

Stress-corrosion cracking caused the pipe to fail. It had been stressed by being bent into an S-shape, to prevent radiation from traversing its length.

As is usual in this type of failure, the cause of corrosion was unforeseen.

To permit movement of the pipe, it was wrapped in kraft paper before the concrete was poured. (Steam pipes expand and contract as the temperature varies.) A layer of pressure-sensitive polyvinyl chloride tape waterproofed the paper. Under the influence of heat, the tape decomposed. Chlorides formed during the decomposition, and migrated through the paper, corroding the stainless steel pipe.

The failed pipe was in a chemical separations plant of the Hanford



Special equipment for swaging and pulling plastic liner.—(Fig. 2)

Shop test of liner and pulling equipment.—(Fig. 3)

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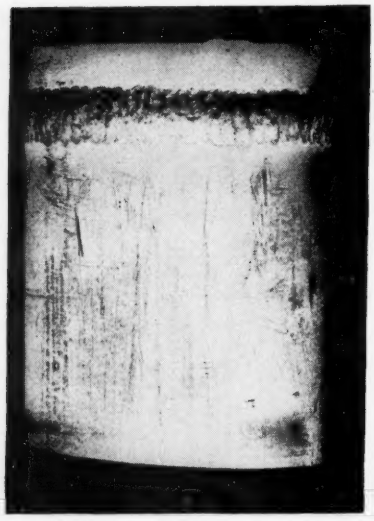
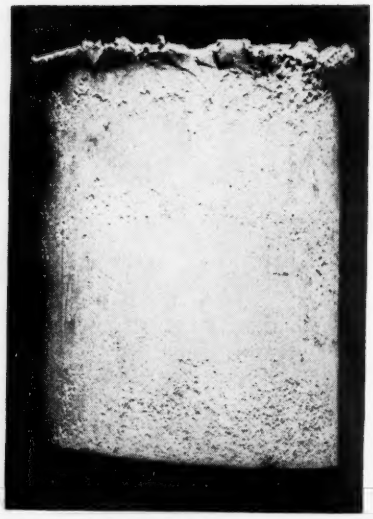


Pipe that protruded from wall (cleaned in HNO_3-HF solution). No pits or cracks. Longitudinal marks made during removal from wall.—(Fig. 4)



Pipe section from inside concrete wall (also cleaned in acid). Note torn appearance of cut end, and pits and cracks on surface.—(Fig. 5)

Atomic Products Operation, Richland, Wash., which General Electric operates for the Atomic Energy Commission. Here, chemical reprocessing of irradiated nuclear-reactor fuel elements is complicated by intense radioactivity from fissioning of uranium atoms. All processing equipment is shielded by massive concrete barriers that protect operating personnel. Using a crane with a radiation-shielded cab, the operator makes equipment changes remotely as he views the work through a periscope.

Plant services, such as process chemicals, steam, water, instrument lines and control circuits reach the processing vessels through stainless steel pipes buried in the thick concrete walls. The pipes are bent into an S-shape to prevent radiation "shine." These service lines are connected to the processing vessels by pipe jumpers remotely installed by the crane. Precise alignment of the service pipe and vessel is essential.

Expansion and contraction of steam pipes embedded directly in concrete causes them to creep, which disturbs the required precise alignment. To avoid this difficulty, the piping is anchored on the process side and provided with an annular clearance between the pipe and the concrete. A wrapping of kraft paper, covered with PVC tape, provides the clearance.

Since the pipe is anchored at the cell end, any movement caused by expansion or contraction takes place through the annulus and appears at the other end in the radiation-free pipe gallery.

► **Piping Failure** — Despite these careful precautions, a leak developed in one of the steam lines after nearly five years of continuous operation. In the specialized irradiated-uranium-fuels processing plant, normal repairs could not be made; all work had to be done from the radioactive-safe pipe gallery side of the wall. Radiation levels at the cell end were 1,000 to 7,000 times the maximum permissible personnel exposure level.

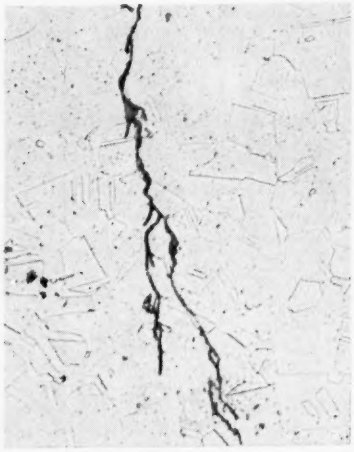
Spare lines were used, and the cause of the failure investigated. Failure of a second line accelerated the investigations. The continued use of a failed line presented the danger that leakage might carry radioactive particles into the radiation-free pipe gallery.

► **Cause of Failure**—The material used in the pipe, the composition of the concrete, analysis of the steam and condensate, and cathodic protection of the concrete reinforcing bars, were all reviewed in an attempt to determine the cause of failure. The pipe's interior was examined with a borescope.

A section of the pipe was removed from the pipe gallery end. The metallurgical laboratory determined that the failure was caused by stress-corrosion attack on the outside surface of the pipe. Figs. 4 and 5 show this section.

Analysis of the kraft paper residue on the outside of the pipe sec-

Photomicrograph of pipe from inside concrete wall. Note cracks to right and left of center pit.—(Fig. 6)



Root of right-hand crack in Fig. 6. Crack is almost completely transgranular in nature.—(Fig. 7)

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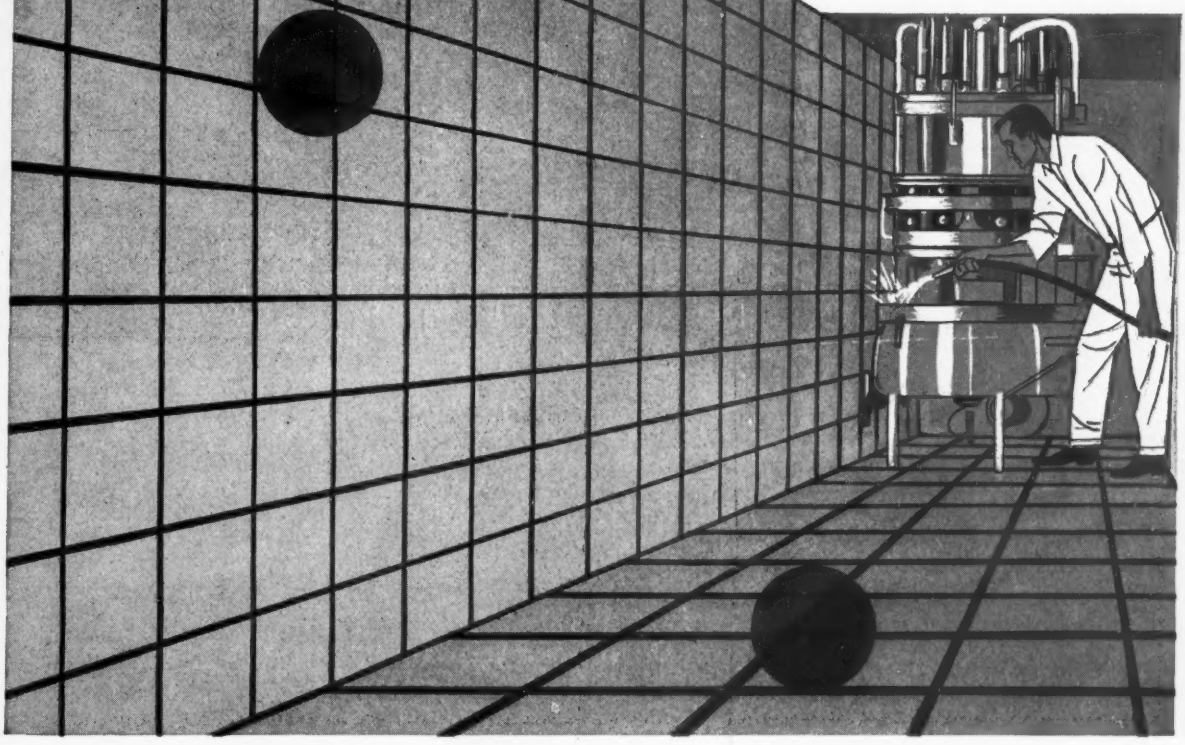

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Duplicate of cracked pipe showing bends through which liner was pulled.

tion revealed a chloride content of 19%. The chloride originated from decomposition of the polyvinyl chloride pressure-sensitive tape that waterproofed the kraft paper wrapping.

▶**Possible Repair Methods**—A repair was mandatory, since coninued operation would eventually lead to the failure of all 148 steam lines buried in the concrete. Suggested methods included installing new lines by core drilling through the seven-foot concrete wall; impregnating the annulus with something (not defined) that would stop the chloride attack; forcing a mixture of iron cement into the cracks by blocking the cell end of the pipe and applying pressure at the gallery end; coating the interior of the pipe with a compound (not defined) and then baking it on; annealing the pipe in place; and welding of the pipe internally with a material not subject to stress-corrosion cracking. None of these procedures appeared practical.

A realistic evaluation indicated that a liner was the only satisfactory solution. The liner material had to withstand chloride stress-corrosion cracking, be able to resist the temperatures and erosion of the steam, be compatible with stainless steel, and be flexible enough to be pulled through the bent pipe from the cell end to the gallery end.

A Teflon (polytetrafluroethylene) compound tube appeared to meet all of the requirements and a procedure for installing it was developed in the shop.

A short metal plug, clamped in the leading end of the tube, was devised for pulling it through the pipe (Fig. 2). One end of each tube section was preformed by the tube manufacturer. This preformed end acted as a gasket between the cell end of the tube and the pipe jumper, thus sealing the inner end. A 30-day shop test of the tube, using steam at 200-psi. pressure, showed no significant deterioration of the plastic.

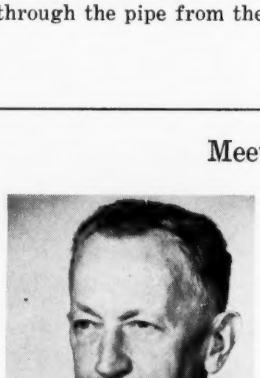
▶**Installation**—In the actual installation, the tube was placed in a horizontal cradle (see Fig. 1) and remotely lowered by the crane to a point directly opposite the end of the failed pipe. The pulling-plug was in place in the end of the tubing. A fish tape (like those used by electricians) with a hooked end was run through the pipe from the gallery end. The tape engaged a loop attached to the pulling-plug in the tube.

The actual connection of the fish tape with the tube was controlled by the crane operator who watched the movements of the units through his periscope. He directed the men in the pipe gallery by telephone. When the fish tape was hooked onto the pulling-plug, the men drew the tube from its cradle into the pipe. They continued pulling the tube around the bends in the failed pipe until the preformed end seated on the pipe nozzle.

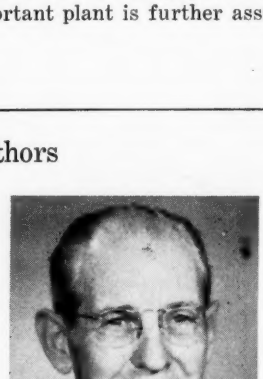
At this point, the installed plastic tube was alternately heated by steam and cooled by water, to remove the pulling stresses and distortion. Then, the pipe gallery end of the Teflon-compound tube was cut to the proper length. A gasket was formed for the flanged connection to a steam line by use of an electrically heated flaring tool.

Thus, a leaking pipe was lined and gasketed at the ends, for future use. Six months of operation have indicated that this was a very practical method of repair of what appeared to be a complete failure. Other pipes are being repaired by this method as they develop leaks, and the continued operation of an important plant is further assured.

Meet the Authors



KENNETH K. CAMPBELL *has been with General Electric since 1946, holding positions such as area engineer and superintendent of maintenance. He has a B.S. from Penn State and is a registered P.E. in Texas.*



PAUL S. KINGSLEY *is a metallurgist at General Electric's Hanford Plant. He has worked for GE since 1945. Before that, he was chief metallurgist for the Follansbee Steel Co., Pittsburgh. He has a B.S. from M.I.T.*

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804 Silicone	60 Toluene	A-3 to A	20-40	2	8.8	3	8	100	8	9	400	600	1	10	Blending Resin
805 Silicone	50 Xylene	C-F	80-150	2	8.4	10	3	8000	3	7	550	1000	10	3	Vehicle for Aluminum Paints
806A Silicone	50 Toluene	D-H	100-200	1	8.5	5	8	2500	7	3	500	1000	5	10	Vehicle for High Gloss Enamels
808 Silicone	50 Xylene	F-J	150-250	2	8.4	9	6	5000	4	6	550	1000	10	10	Vehicle for High Gloss Enamels
840 Silicone	60 Toluene	A-1 to A-3	15-25	2	8.8	5	7	900	7	9	450	800	5	9	Blending Resin
R-60031 Silicone-alkyd Copolymer	50 Cellosolve Acetate, Toluene	D-L	100-300	4	8.8	10	10	500	10	10	450	600	10	10	Vehicle for Appliance, Exterior Enamels (Baking Type)
XR-60032† Silicone-alkyd Copolymer	60 Mineral Spirits	V-Y	750-1500	6	7.8	10	9	100	9	3	400	800	10	9	Vehicle for Maintenance Paints (Air Dry)

* Relative Comparison: 1 = very poor; 10 = excellent. † Available in trial samples only.

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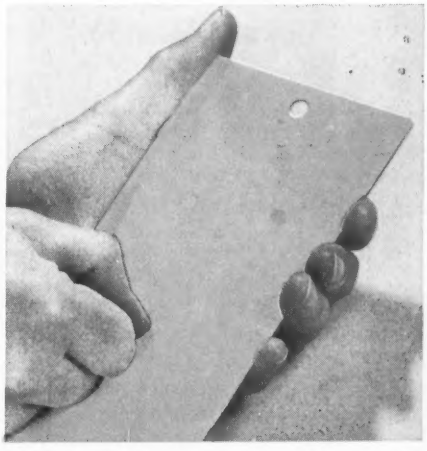

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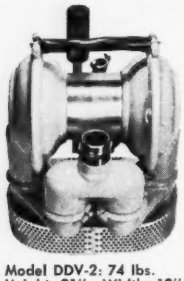

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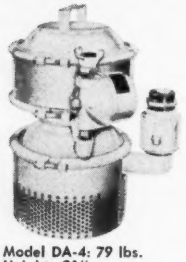

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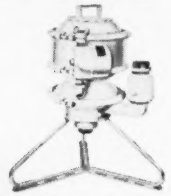

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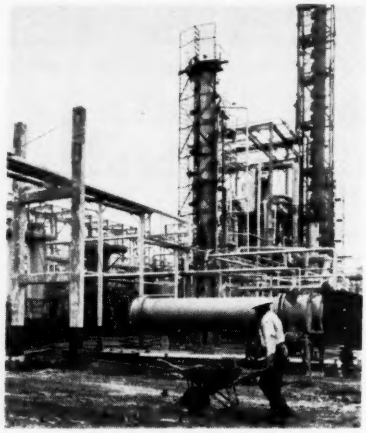
CUDAHY, WISCONSIN

Continued from page 76

camera that takes motion picture frames at 10 millionths of a second, and a machine that turns out 3,000 ft./min. of paper from experimental pulps.

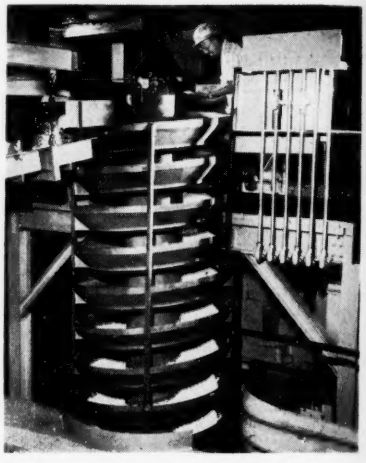
American Oil Co. plans to bring its Casper, Wyo., crude-oil distillation unit on stream by Sept. 1. Now under construction, installation will replace two batteries of outmoded stills that process 37,000 bbl. of crude daily. Fractionated streams are further refined into gasoline, distillates, lube oils, wax and asphalts.

At the same time, company announces that it will build a similar, 70,000-bbl./day unit at its Sugar Creek, Mo., refinery. New distillation tower will boost crude throughput at the site by 50% when it comes on stream in July 1962.



Copolymer Rubber & Chemical Corp.'s $5-million expansion of its butadiene facilities (*above*) is nearing completion in Baton Rouge. Begun last year as part of an $8-million modernization and expansion program, the move boosts company's butadiene capacity by 50%.

Morton Chemical Co., a subsidiary of Morton Salt Co., has signed a long-term contract with Borden Chemical Co., to supply an undisclosed amount of anhydrous hydrogen chloride to Borden's subsidiary, Monochem Inc. To do so, Morton will build a plant near Monochem's petrochemical complex at Geismar, La., by early 1962. And the firm is studying the feasibility of producing other chemicals at its newly acquired site as well.

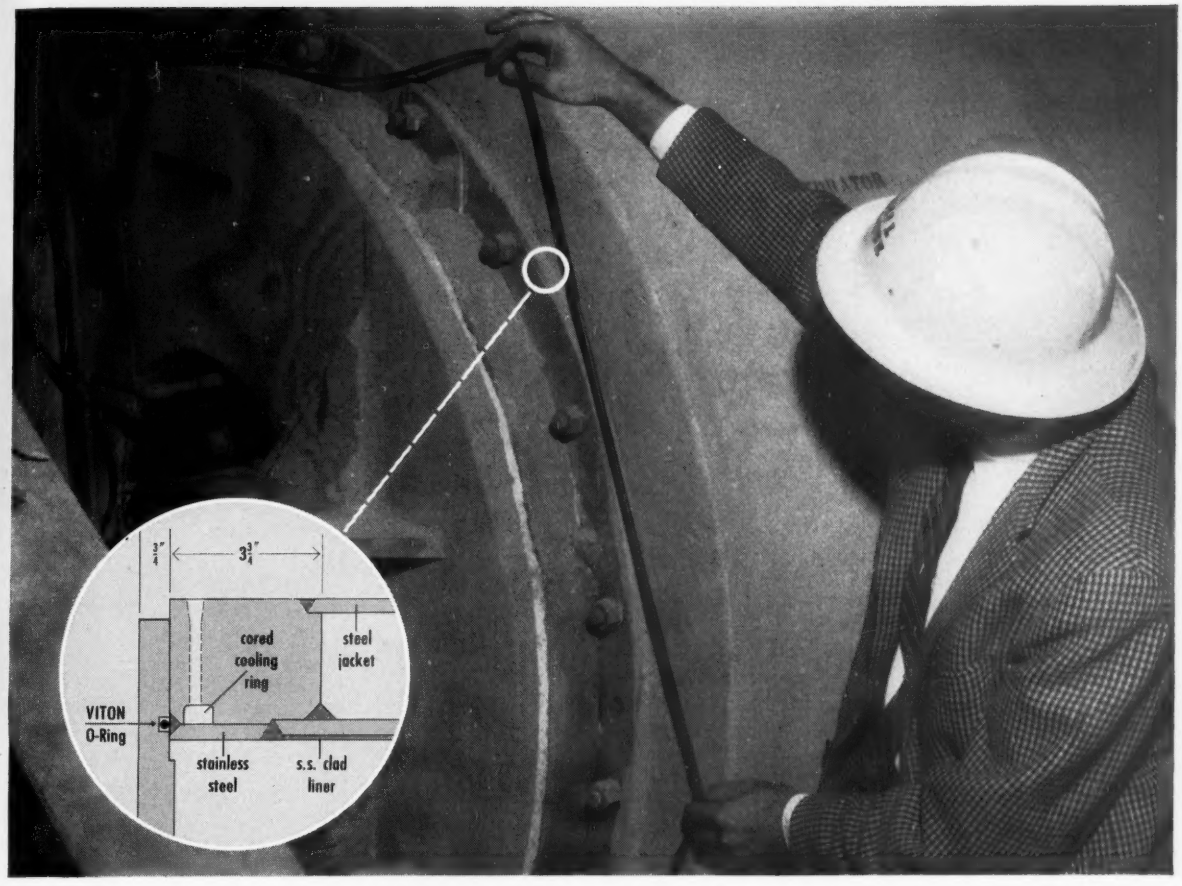


The Goodyear Tire & Rubber Co. has installed a $1.3-million battery of stainless steel equipment at Houston, Tex., to produce 13 high-purity styrene-butadiene rubbers. Said to be the only factory in the rubber industry in which stainless is used on all interior as well as exterior equipment surfaces, the 245,000-long ton/yr. facilities include the vibrating, spiral crumb-rubber conveyor shown above.

Pennsalt Chemicals Corp. will nearly double its capacity for alkyl amines at Wyandotte, Mich., by early 1962. Project will cost $2 million, will boost the output of ethyl amines, isopropyl amines and butyl amines.

Consolidated Vacuum Corp. has installed at its Philadelphia steel mill what it believes to be the world's largest vacuum arc furnace. The open-hearth unit produces 40-ton, 60-in.-dia. ingots—a far cry from the 1- or 2-kg. ingots that were thought to be a maximum vacuum-arc product as late as 1950, when the kiln was still a laboratory workpiece.

General Graphite Co. has begun a $500,000 expansion at its Ashland, Ala., graphite plant. Capacity is



VITON O-rings are used to seal end flanges on high-temperature chemical plant vacuum drier. Here, position is indicated by mate to seals actually used. Inset shows assembly detail.

Searing 572° F. Heat No Match for Sealing System Using VITON® O-Rings!

The problem: sealing the flanges at either end of a horizontal, agitated, high-temperature vacuum drier custom-built for a chemical plant. Heat transfer fluid in the jacket of the drier condenses at 572° F.—inches away from the end flanges. Needed was a sealing system that would work dependably—despite searing temperatures plus constant exposure to acidic reaction components.

The solution: a pair of king-size O-rings made of heat and acid resistant Du Pont VITON synthetic rubber, coupled with a cored cooling ring to help dissipate heat. The VITON flange gaskets have already been in service several hundred hours without a sign of a defect —and in this severe service, gasket deficiencies show up quickly. Based on performance to date, the VITON gaskets are expected to last the life of the equipment itself!

Learn more about VITON. In addition to acids, corrosive chemicals and heat as high as 600° F., Du Pont VITON repeatedly demonstrates its unmatched resistance to oils, fuels and solvents . . . also withstands long exposure to ozone and weathering. Ask your preferred rubber goods supplier for products of VITON for severe service applications. For complete technical data on VITON's use in O-rings, gaskets, tubing, hose and a host of other resilient parts, write E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Department CE-8, Wilmington 98, Delaware.

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being tripled, to 600 tons/day. Much of the output is slated for National Carbon Co., which will experiment with graphite in solid-fuel propellants at a $12-million Columbia, Tenn., laboratory now being built by the National Aeronautics and Space Administration.

B. F. Goodrich Co. will spend $2 million to expand and modernize the Akron, Ohio, factory in which its airplane and other off-the-highway tires are made. Due completed by the end of the year, project is part of a $10-million program initiated in 1960.

The Ohio Oil Co. has jumped crude throughput at its Robinson, Ill., refinery from 50,000 to 55,000 bbl./day. Construction centered on the crude distillation tower and fluid catalytic cracker, although gas-oil charge was also raised from 20,000 to 24,000 bbl./day.

Offices

Celanese Corp. of America has moved its corporate headquarters from Madison Ave. to 522 Fifth Ave., New York.

General Aniline & Film Corp.'s Antara Chemicals Div. has opened a southwestern district office in Houston.

B. F. Goodrich Industrial Products Co., a division of The B. F. Goodrich Co., has split its eastern seaboard adhesive sales office into a New York/New England center at Shelton, Conn., and a Philadelphia office to serve the remaining states from New Jersey to Virginia.

Companies

Koppers Co., Pittsburgh, and **Courtaulds, Ltd.**, London, have completed what is described as "a first step in plans for the exploration of areas of mutual interest." Fred C. Foy, chairman of

the board of Koppers, and J. Albert Woods, chairman of the board of Courtaulds North America Inc., revealed that "over the past few months, Courtaulds has acquired an interest in Koppers' common stock." More than 100,000 shares are involved, about 4-5% of Koppers' outstanding shares. Neither of the men feel that it is "timely to discuss specific fields at this time." But both Woods and Arthur W. Knight, a director of Courtaulds, Ltd., have been elected to Koppers' board.

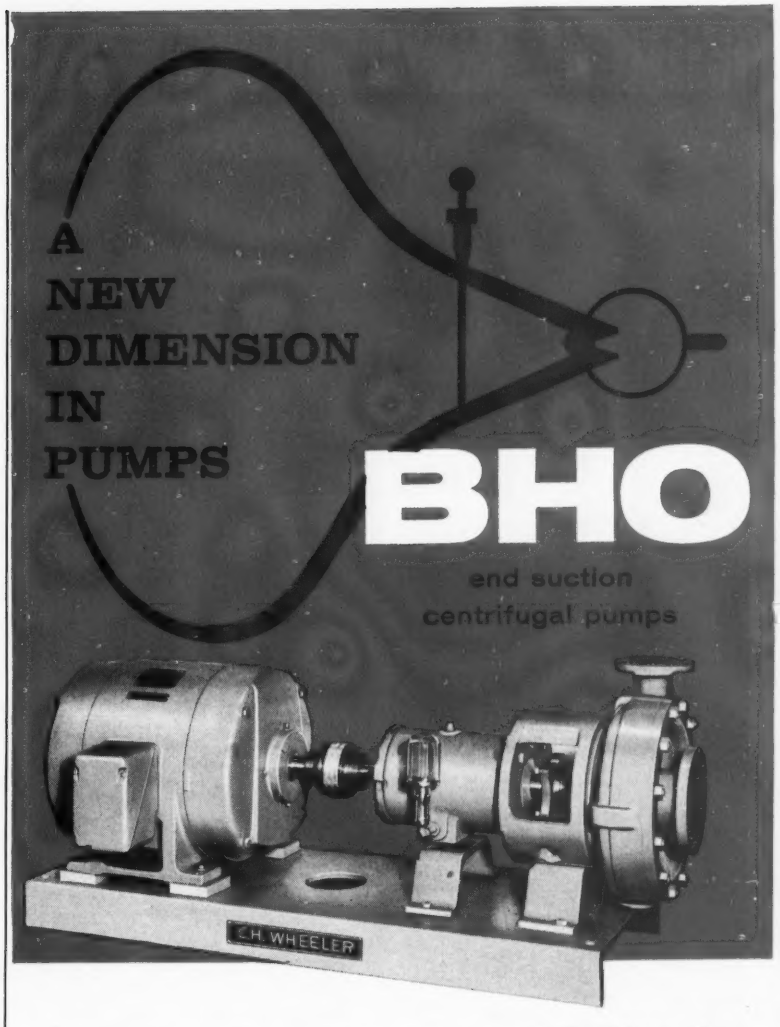
American-Marietta Co. and **The Martin Co.** plan to consolidate, creating a new, as-yet unnamed, corporation to operate the current firms as divisions. Present American-Marietta shareholders would get one share of the new company's common stock for each they now hold, while current Martin stockholders would get 1.3 shares.

Virginia-Carolina Chemical Corp. has bought 1 million of the authorized 5 million shares of Texas International Sulphur Co. (of which, 4.5 million are outstanding). Virginia-Carolina thus gets working control of the Houston-based mining corporation.

International

New Zealand's first oil refinery is planned for Marsden Point, Whangarei, Auckland, by the newly created New Zealand Refining Co. Ltd. Due on stream early in 1964, installation will process 50,000 bbl./day of crude into 90% of the island's annual requirements of petroleum products (all of which are currently imported from Australia).

Japan: Mitsubishi Oil Co. plans a kaleidoscopic petrochemical complex for Mizushima, Okayama. Included in the plans now being drawn up with an affiliated firm, Mitsubishi Kasei K.K., are units to turn out 63,200 tons/yr. of acetaldehyde, 43,100 tons of ethylene, 33,200 tons of propylene, 15,-



Dimensioned to your requirements, this new C. H. Wheeler development is the most modern pump available for the chemical, process, heating, ventilating and air-conditioning industries.

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A complete range of 14 pump sizes from 1″ to 5″ in both series. The size and type you need to do your job. Available for immediate shipment.

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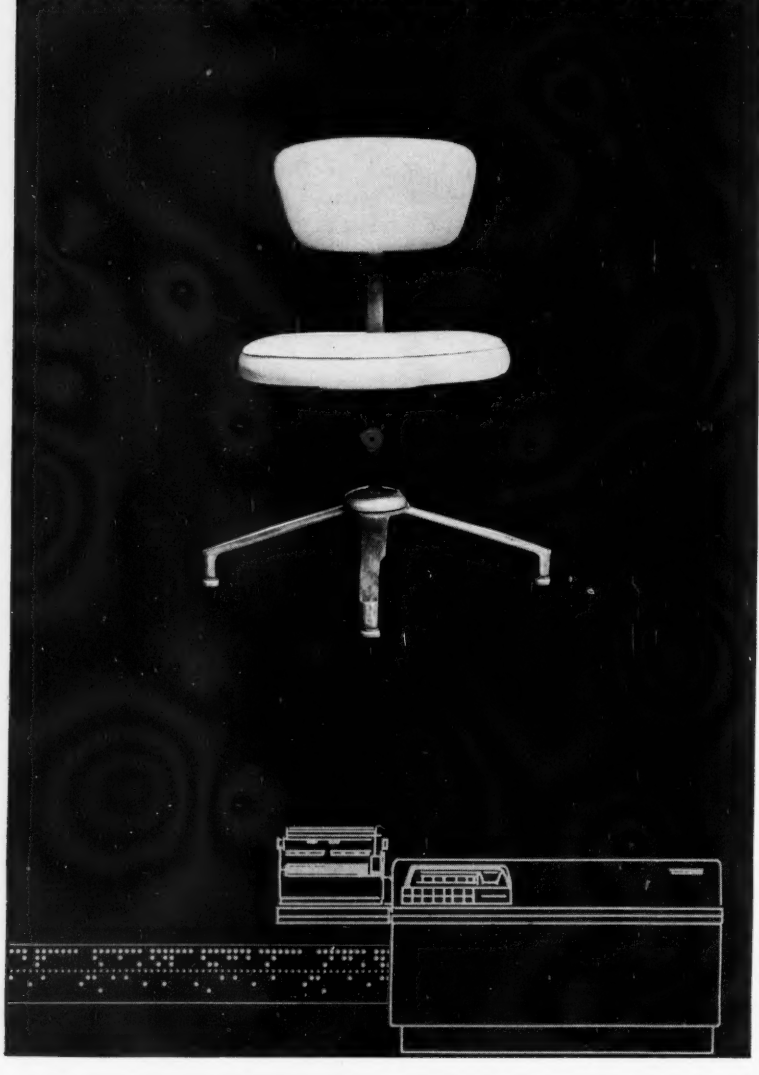

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000 tons of acetone, 7,200 tons of acrylonitrile, and 6,000 tons of octanol. To feed the petrochemical units, Mitsubishi plans to erect a 200,000-bbl./day crude refinery (in addition to the $22.2-million, 40,000-bbl./day installation it just placed on stream at the site in April). Complex is scheduled for completion by January 1964.

San Salvador: Continental Oil Co. and National Bulk Carriers Inc. have jointly proposed for government approval a $6-million ammonia plant at Acajutla. Last year, Fertica de Panama (an affiliate of Standard Oil Co. of New Jersey) proposed a similar installation; but negotiations bogged, and the Panamanian firm never registered a Salvadoran subsidiary.

Canada: Eldorado Mining and Refining Ltd. plans to install at Port Hope, Ont., what it describes as one of the world's largest vacuum induction-melt furnaces. Consolidated Vacuum Corp. is erecting the $100,000 unit, which when completed next year will produce "almost" pure ingot uranium.

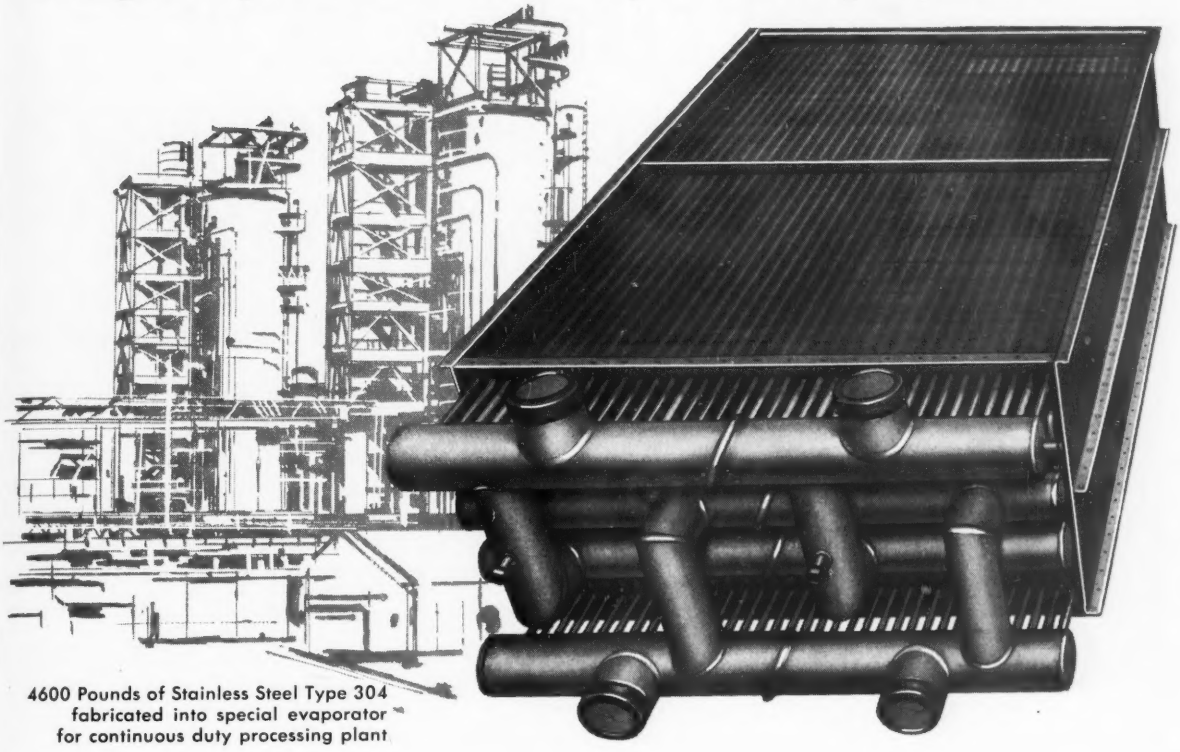
India: The India Rubber Regeneration Co. will be supplied by West German interests with a rubber-reclamation plant for Thana, Maharashtra State, about 30 miles southeast of Bombay. Facility will reclaim 2,400 tons/yr. at first, but eventually step up production to twice that figure.

People

William M. Haile and **Kenneth Rush** have been elected executive vice presidents of Union Carbide Corp. Former president of Linde Co., Haile was simultaneously appointed a director of Carbide. Rush has been a director since 1958.

Gilbert R. Shockley has been named general director of product development by Reynolds Metals

Designed by Marlo to Your Performance Specifications



4600 Pounds of Stainless Steel Type 304 fabricated into special evaporator for continuous duty processing plant

Stainless Steel Extended Surface Heat Exchanger

Typical of the kind of special custom fabrication produced by Marlo know-how for the process industries, this unit has these specifications:

Duty: 2,000,000 B.T.U. per hour
outside surface: 10,700 square feet
inside surface: 830 square feet
surface ratio: 12.9 to 1

size:
length: 100 inches
width: 60 inches
height: 30 inches
dry weight: 4600 pounds

materials:
tubing: ¾" O.D. — 304 stainless steel
headers: 5" O.D. — 304 stainless steel
fins: 0.010" — 304 stainless steel
frame: 0.190" — 304 stainless steel
working pressure: 400 psi

Put our experience to work on your special heat exchange equipment. Contact the Marlo office nearest you, or write for further information.

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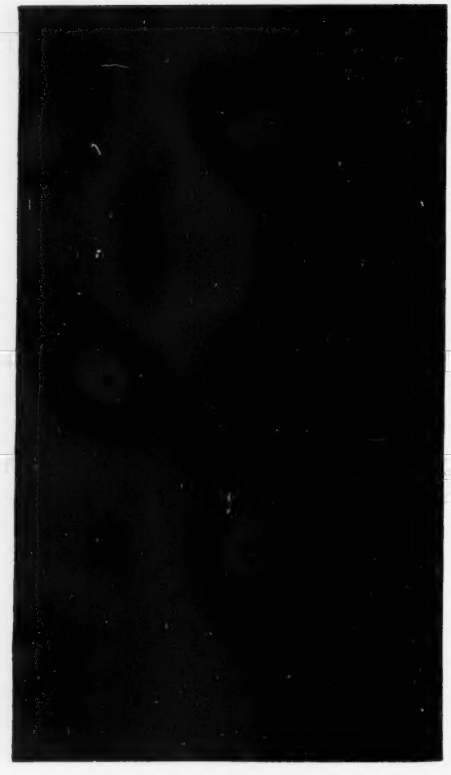

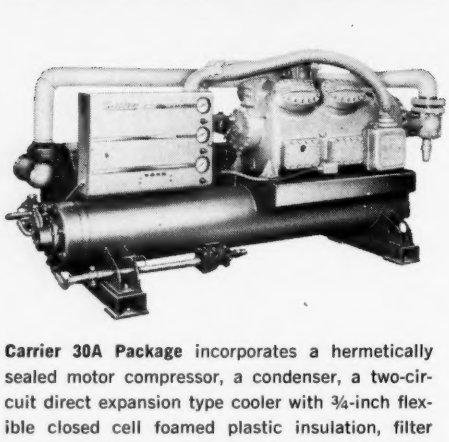

Carrier 30A Package incorporates a hermetically sealed motor compressor, a condenser, a two-circuit direct expansion type cooler with ¾-inch flexible closed cell foamed plastic insulation, filter dryer, moisture indicator, liquid line sight glass, crankcase heater, thermal expansion valves, starting equipment and controls, interconnecting wiring, and refrigerant piping. Model 30B packages are essentially the same but condenserless.

Now in 75, 80, 90, 100, 115 and 125 ton capacities

CARRIER HERMETIC RECIPROCATING LIQUID CHILLING PACKAGES

with Automatic Capacity Control for economical operation

For air conditioning an office building, apartment or hotel . . . or for a central supply of chilled water for process or product cooling . . . these new Carrier packages offer many advantages over other models. They are compact in size and light in weight with favorable tonnage increment offerings. Now six nominal capacity steps allow a more economical selection with optimum performance—performance that provides your clients with worth-while operating savings through Automatic Capacity Control.

This control, built into the compressor and actuated by suction pressure, varies the capacity in response to cooling load requirements. Power savings are substantial when the unit is operating under partial loads. During start-up, the controlled cylinders are automatically unloaded for further power savings.

These new Carrier packages are available in two models—the water-cooled 30A and condenserless 30B—both factory-assembled and mounted on steel rails for simplified installation. For complete details about these new packages, write Carrier Air Conditioning Company, Syracuse 1, New York. In Canada: Carrier Air Conditioning Ltd., Toronto 14.

Carrier ***Air Conditioning Company***

Co. Shockley was vice president for metals in the international division of Olin Mathieson until 1953.

Austin R. Zender and **D. Swing Starring** have been elected directors of National Distillers and Chemical Corp. Zender assumes additional responsibilities as chairman of the executive committee. Appointments were effective upon the merger of Bridgeport Brass Co. into National Distillers.

Charles D. McCleary is the new director of research and development for U. S. Rubber Co.'s Naugatuck Chemical Div. He replaces Wesley S. Coe, recently elected managing director of Petroquimica, S. A., the five-firm petrochemical venture in Argentina.

R. E. McGee, formerly treasurer of Tenneco Corp., has been named vice president and treasurer. Also appointed to vice presidencies were **James E. Ivins, E. L. Capps,** and **E. R. Karter.**

Orlando A. Battista has been promoted to manager of corporate applied research at American Viscose Corp. He is credited as coinventor of Avicel, the firm's new microcrystalline cellulose.

John W. Anderson has been named vice president of engineering for Minneapolis-Honeywell Regulator Co.'s Electronic Data Processing Div.

W. Donald Thompson has been appointed manager of research and development for Hercules Powder Co.'s Fiber Development Dept. Immediate responsibilities center on polypropylene fiber development at Covington, Va.

Robert C. Hyatt has been named director of marketing for General Aniline & Film Corp.'s Antara Chemicals Div.

David H. Thompson has been appointed head of the chemical metallurgy research division of Anaconda American Brass Co.

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BULLETIN D-20 — Dual-Clone dust separators — noted for their low resistance and high cleaning efficiency. Easy to install, no maintenance, no moving parts.

BULLETIN I-585 — Industrial Fans. Complete with helpful selection charts, capacity tables, dimensions and specifications. Information on special types and arrangements included.

BULLETIN F-75 — Reverse Jet Dust Filter Facts. Complete with specifications, typical equipment layouts, capacity and performance tables for DAY type "AC" filter.

BULLETIN N-578 — Gives complete information about Style "A" rotary valves. Construction features, specifications, dimensions and applications.

"SCHLITZ DEFEATS DUST" — FOOD ENGINEERING magazine reprint describes all out dust control for 3½ million bushel Schlitz grain elevator. Request Bulletin "Schlitz" Defeats Dust."

"EFFICIENT DUST SNATCHERS" — Bulletin describes DAY's part in providing maximum safety and good housekeeping for starch packing building of large food processor.

BULLETIN 510—DAY Unit Dust Collectors. Complete, low cost unit designed for plants or applications where central dust control systems are not practical.

BULLETIN 576 — "HV" heavy duty dust separator Rugged construction and lower initial cost than many light gauge galvanized type cyclones.

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☐ Bulletin I-585 ☐ "Schlitz Defeats Dust" ☐ Bulletin 576

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Convention Calendar

August

14-17. Louisiana State University, Ninth Annual Short Course in Fundamentals of Occupational Safety, Baton Rouge, La.

14-18. Gordon Research Conference, Instrumentation, Colby Junior College, New London, N. H.

15-17. University of Michigan, Cryogenic Engineering Conference, Ann Arbor, Mich.

15-18. Technical Assn. of the Pulp and Paper Industry, Testing Conference, Queen Elizabeth Hotel, Montreal, Que.

21-31. United Nations Conference on New Sources of Energy, Ciro Massino, Rome, Italy.

21-1. Wayne State University, International Conference on Coordination Chemistry, Detroit, Mich.

22-25. Western Electronics Show and Conference, Cow Palace Hotel, San Francisco, Calif.

28-31. Mathematical Assn. of America, Summer Meeting, Oklahoma State University, Stillwater, Okla.

28-1. American Society of Mechanical Engineers, International Conference on Heat Transfer, University of Colorado, Boulder, Colo.

September

3-8. American Chemical Society, National Meeting, Chicago, Ill.

6-8. Assn. for Computing Machinery, Annual Meeting, Statler-Hilton Hotel, Los Angeles, Calif.

6-8. Massachusetts Institute of Technology, International Symposium on Transmission and Processing of Information, Cambridge, Mass.

7-8. The Combustion Institute, Western States Section, Fall Meeting, University of California, Berkeley, Calif.

11-15. Instrument Society of America, 16th Annual Instrument, Automation Conference & Exhibit, Biltmore Hotel and Memorial Sports Arena, Los Angeles, Calif.

11-15. National Industrial Conference Board, Stanford Research Institute, International Industrial Conference, Fairmont Hotel, San Francisco, Calif.

12-15. Pennsylvania State University, Seminar for Manufacturing Engineers, University Park, Penna.

14-15. American Society of Mechanical Engineers, American Institute of Electrical Engineers, Engineering Management Conference, Hotel Roosevelt, New York, N. Y.

17-22. Pennsylvania State University, Work Measurement Course, University Park, Penna.

18-20. Canadian Agricultural Chemicals Assn., 9th Annual Meeting and Conference, Mont Tremblant Lodge, Mont Tremblant, Que.

18-20. Standards Engineers Society, Annual Meeting, Hotel Sherman, Chicago, Ill.

22-1. 1st International Plastics Fair of Denmark, Forum, Copenhagen, Denmark.

24-27. American Institute of Chemical Engineers, National Meeting, Lake Placid, N. Y.

24-27. American Society of Mechanical Engineers, Petroleum Mechanical Engineering Conference, Muehlebach Hotel, Kansas City, Mo.

24-27. American Institute of Electrical Engineers, American Society of Mechanical Engineers, National Power Conference, St. Francis Hotel, San Francisco, Calif.

25-28. American Welding Society, Fall Meeting, Adolphus Hotel, Dallas, Tex.

25-28. Industrial Building Exposition & Congress, New York Coliseum, New York, N. Y.

28-29. American Production and Inventory Control Society, 4th Annual National Conference and Technical Exhibit, Pick-Congress Hotel, Chicago, Ill.

28-30. American Society for Quality Control, Chemical Div., 5th Annual Chemical Conference, Daniel Boone Hotel, Charleston, W. Va.

October

2-3. Engineers Council for Professional Development, Annual Meeting, Louisville, Ky.

2-7. International Astronautical Federation, 12th International Astronautical Congress, Washington, D. C.

Later

October 11-12. CHEMICAL ENGINEERING and Armour Research Foundation, Conference on the New Trends in Chemistry, Sheraton Towers Hotel, Chicago, Ill.

November 27-December 1. 28th Exposition of the Chemical Industries, New York Coliseum, New York, N. Y.

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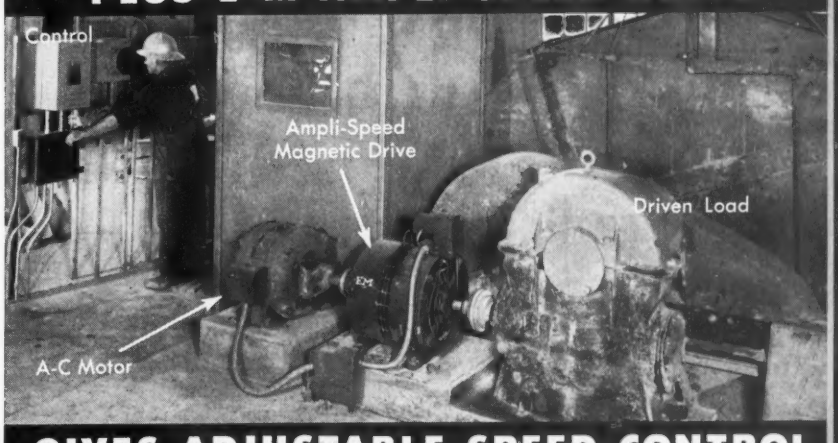
PLUS E-M AMPLI-SPEED DRIVE



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. . . it's that easy to have precise, adjustable speed control on fans, compressors, centrifugal pumps, conveyors, a-c frequency stabilizers, machine tools, etc.

Ampli-Speed is a simple, compact magnetic slip coupling that is:

EASILY ADAPTED – it may be either belted or coupled to your motor and load.

SIMPLE TO INSTALL – it's air cooled and can be handled and installed just like a motor.

EASY TO CONTROL – speed is changed by simply turning control potentiometer . . . output may be controlled automatically, too, by pressure, level, or combustion devices.

Ampli-Speed has nearly stepless speed change and gives speed regulation within ± 2%. It's available in these integral horsepower ratings: thru 310 hp for variable torque loads; thru 75 hp for constant torque loads. Input speeds can be 860 thru 1750 rpm.

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Somewhere in your plant an operation can be improved with adjustable speed control . . . DO IT YOURSELF WITH AMPLI-SPEED

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Check the Advantages of Dynaclone® Dust Filters

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SLY TUBE-TYPE FILTER
Tubular bags wasted space in the filter.

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SLY "ROLL-CLEAN" DYNACLONE:
37% more filtering area in the same space.

COMPACT DESIGN MEANS 20-40% MORE FILTERING CAPACITY

Modern flat bag design is one reason why Sly outperforms other dust collectors. It provides 20 to 40% more cloth in a given space — greater filtering capacity per cubic foot of filter. The Dynaclone and other Sly Dust Filters fit in where others can't. Yet bags are more easily accessible.

The "Roll-Clean" Dynaclone also operates continuously, provides *constant* suction at dust sources for complete dust suppression.

It is automatically self-cleaning. The roller cleaner seals off bags one row at a time for cleaning by reverse air. A single exhaust fan provides suction for dust collection *and* air for cleaning. There are no auxiliary blowers.

And "Resist-O-Wear" bags give 2 to 3 times longer life on the most demanding applications.

Check *all* the Dynaclone advantages . . . *Send for 36-Page Catalog 104.*

"Roll-Clean" Dynaclone: Patents 2,867,289, 2,938,598. "Resist-O-Wear" Filter Bags: Patent 2,959,247.

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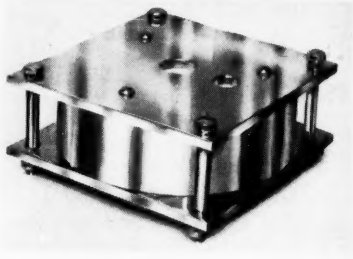
NEW EQUIPMENT . . .
Continued from page 88

measuring purposes via a transistorized electronic unit incorporating a piezomagnetic transducer.

The meter has only one moving part, an air bearing with no metal-to-metal contact, which eliminates bearing failure due to dusty or corrosive atmosphere. Seven models with 2 to 14-in. spout sizes comprise the complete line.—**Industrial Powertronix, Inc., Portland, Ore.** 88D



Nonmetallic filter

Submicron unit suitable for heat- and metal-sensitive materials.

Pharmaceutical and chemical products that are heat sensitive and also must not contact metal can be filtered and sterilized with this submicron unit. Sterilization is achieved by filtration through a membrane.

Designated Model MF-30T, the filter is made of Teflon. Since this material withstands sterilization temperatures, the entire unit can be autoclaved before use.

Throughput is 5-100 gph., depending on the nature and pressure of the fluid.—**Barnstead Still & Sterilizer Co., Boston.** 172A

Removable-blade agitator

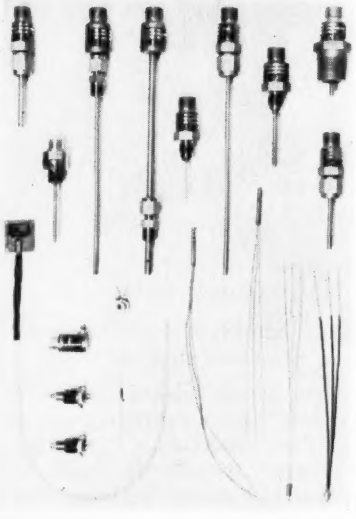
Blades can be replaced through a manhole without disturbing shaft.

No large manhole is needed to accommodate the agitator on vessels that use a removable-blade type on which the blades can be replaced without disturbing the agitator shaft or drive. A 12 × 16-in. oval manhole suffices to

place the agitator assembly into a vessel.

Sealing of the blade joint, which can be a problem in typical corrosive service where glass-lined equipment is used, is accomplished by using special resilient materials and gaskets. The agitator can be installed close to the bottom of the vessel for maximum mixing efficiency.

Considerable time can be saved when working with clamped-top reactors, as the agitator can be inspected or replaced without removing the top head and gasket assembly. If one blade is damaged, it can be replaced without replacing the entire agitator assembly. **—Glascote Products, Inc., Cleveland.** **172B**



Temperature transducers

Small units accurately measure temperatures from —452 to 1,750 F.

A line of temperature transducers includes static-to-low-flow, medium-flow, high-flow and enclosed probes that contain sensing elements of tungsten, platinum, copper, nickel and other materials. One-piece stainless steel construction aids resistance to thermal and mechanical shock.

Said to operate in practically any solid, gaseous or liquid medium (with enclosed units for cor-

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PHYSICAL PROPERTIES:	TYPE I (SEILON CR-HT)	TYPE II (SEILON HI-HT)
Specific Gravity	1.56	1.56
Rockwell Hardness	118	118
Tensile Strength, psi	8,900	8,000
Flexural Strength, psi	17,000	14,500
Izod Impact, ft./lbs./inch notch	0.5	4.0
Heat Distortion Temperature @ 264 psi, °C	103	103
Dielectric Strength (volts/mil)	1,200	1,300

Let us demonstrate this remarkable new material to you. We welcome the opportunity to consult with you on individual specifications of properties, gauges, colors and finishes for your product, and to recommend ideal handling methods for SEILON thermoplastics.

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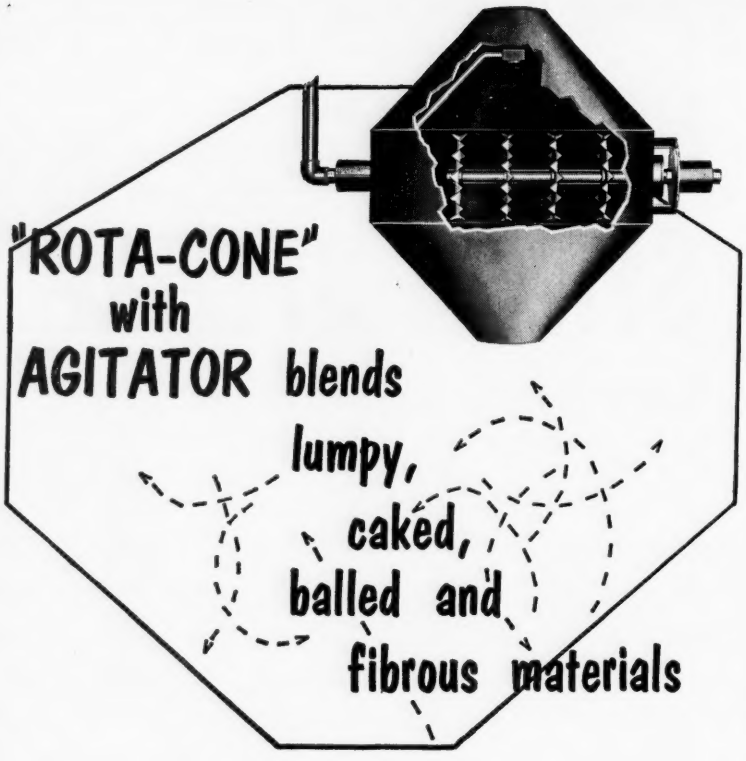

The Paul O. Abbé "Rota-Cone" Blender, with internal agitator, readily blends lumpy, caked, balled and fibrous materials.

For example, many fine mesh powders become caked into relatively firm lumps. The "Rota-Cone" Blender breaks up and restores such caked or lumped materials to their original fineness for blending with other powdered ingredients.

Again where caked powders are treated with a liquid additive, the internal agitator restores the powder to its original fineness, before the atomized spray is added. Breaking, blending and liquids-addition are all accomplished in one unit.

Some materials, tend to form balls while being blended. The internal agitator prevents this "balling" and permits quick, thorough blending.

The "Rota-Cone" Blender produces blended fibrous materials from formulations, including tight fibrous clusters which must be opened or fluffed before adding to the batch. It fluffs these clusters and blends—all in one operation—with high degree of efficiency.

Where shortening or other fatty content has to be cut into the powdered materials the "Rota-Cone" produces a perfect blend.

The "Rota-Cone" can help you, too, to solve your difficult blending problem.

For complete details of Paul O. Abbé Blenders, write today for our 12-page catalog "C-1".

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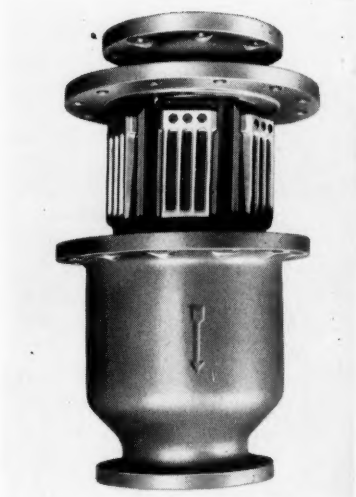
rosive service), the devices are guaranteed accurate within 0.1% of range. Special units have 0.01% accuracy.

Sensing elements are wound to provide maximum exposure to the medium, consistent with rapid response, mechanical strength and resistance to corrosion. Extremely small-diameter probes are a feature of the new line.—**Temtro, Inc., Santa Ana, Calif.** 173A



Check valve

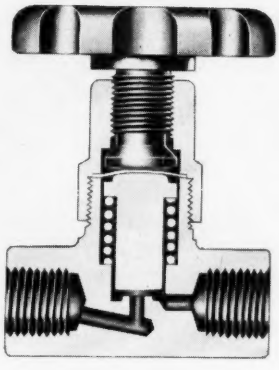
Device handles high-volume gas flow, gives low pressure drop.

This check valve is especially suitable for use with large-volume gas flow, according to the manufacturer. Rapid and quiet response is claimed, with straight-through flow and low pressure drop as operating characteristics.

Backflow is controlled by stainless steel leaves retained by keepers; hence there are no rotating, sliding or high-intertia moving parts internally. Metal-to-metal contact provides the seal, avoids problems of reaction that occur between some gases and nonmetallic sealing elements.

The valve may be mounted in any position in a pipe or compressor discharge line. It withstands pressures up to 1,000 psi., comes with cast iron, cast steel or alloy steel bodies in sizes from 6 to 48

in.—**Clark Bros. Co., div. of Dresser Industries, Inc., Olean, N. Y.** 174A



Diaphragm valve

This and companion metering valve are designed for corrosive service.

Two valves are now available for use on corrosive-gas instrumentation, control and similar processing lines. Both feature small internal volume to minimize areas subject to corrosion.

Type 5939 has a metal diaphragm that provides pressure-tight operation from 0.05 microns vacuum to 2,500 psi. at temperatures from −60 to +400 F.

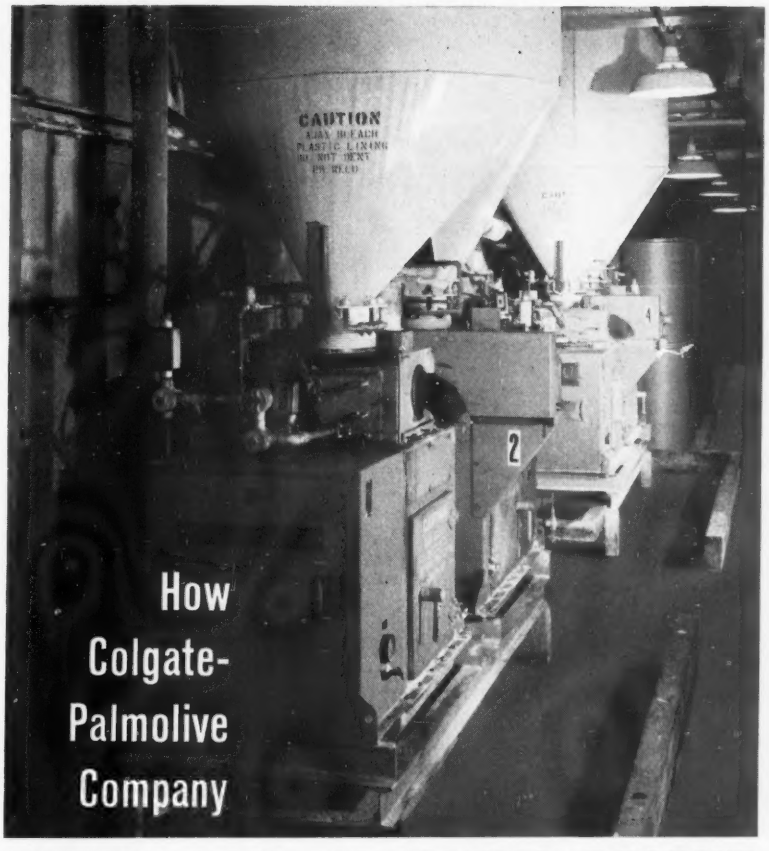
Type 5940 is a metering valve with stem threads isolated from line contents by Teflon packing. It operates over approximately the same temperature and pressure ranges.

Standard units are made of brass, Type 303 stainless steel, and aluminum silicon bronze, which is particularly suitable for use with fluorides, chlorides and other anhydrous halogen gases.—**Superior Valve and Fittings Co., Pittsburgh.** 175A

Low-capacity pump

Liquids or gases are pushed through a flexible plastic tube.

For low-capacity pumping operations, this electronically controlled pump provides a variable flow rate from 1.5 to 8.1 gph.



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...with Richardson Automatic Scales

Housewives like AJAX. It leaves sinks and tubs so sparkling clean and bright . . . and a quality-conscious management knows their sales are safe as long as they get exactly the right amount of bleach in each batch. Too little affects cleaning qualities. Too much creates unpleasant odors and a hazard to tender skin.

Colgate-Palmolive Company depends on Richardson Automatic Scales for this all-important quality control job—getting just the right amount of bleach per batch. Richardson's know-how in all kinds of process automatic weighing comes from thousands of installations in plants all over the world. Richardson means reliability . . . the ability to stand the gaff of day in, day out operation. Why not call in a Richardson automatic weighing specialist for your application. Phone or write **Richardson Scale Company, Clifton, N. J.**

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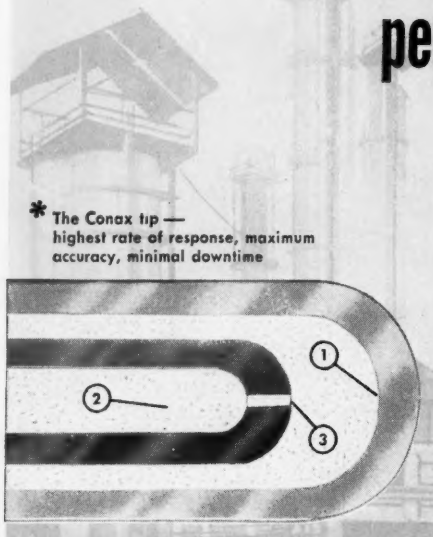
MATERIALS HANDLING BY WEIGHT SINCE 1902

here's a tip* on thermocouple performance



* The Conax tip — highest rate of response, maximum accuracy, minimal downtime

1. In ungrounded junctions, maximum rate of response is achieved through maintenance of true cylindrical sections. Well closures are the same thickness as sheaths. (Grounded junctions also provided.)
2. Eliminates oxidation and danger of collapse by isolating the thermocouple in densely compacted insulation that completely fills the area . . . prevents vibration damage.
3. Eliminates corrosion and contamination potential arising from the use of fluxes through exclusive Conax electrical welding techniques.

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ordinary thermocouple tip — slow, inaccurate, short-lived.

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Pumping is accomplished by progressive kneading of a vinyl tube.

A separate controller unit houses a d.c. power supply and transformer, which operate in conjunction with a specially wound motor that is able to satisfy the high torque requirements of the pump, particularly at low speeds. Constant torque is maintained over the full speed range to aid close control of flow rate.

Only nylon fittings and the vinyl tubing come in contact with the material being pumped, hence the unit can handle a wide variety of chemical solutions, viscous fluids and gases, without contamination of product or corrosive action on pump parts.—**Cole-Parmer Instrument & Equipment Co., Chicago.** 175B

Briefs

Pneumatic pressure controller has adjustable proportional band to overcome system cycling and time lags, may be adjusted with a single knob. Built to withstand outdoor installation, the unit can be used either in corrosive service or atmospheres.—**Leslie Co., Lyndhurst, N. J.** 176A

Gas chromatograph has separately heated column and detector cell to facilitate manual programming of column temperature. Columns, detector cell and injector temperatures are indicated on a compensated pyrometer.—**Wilkins Instrument & Research, Inc., Walnut Creek, Calif.** 176B

Sample cooler is counterflow heat exchanger for cooling high-temperature and high-pressure fluid samples such as boiler water and hot chemical solutions. Inner Inconel seamless tubing coil is enclosed in stainless steel outer shell.—**Hagan Chemicals & Controls, Inc., Pittsburgh.** 176C

Batch mixer has mixing action said to be 30-80% more efficient than conventional ones. Three vertical agitators overlap and in-

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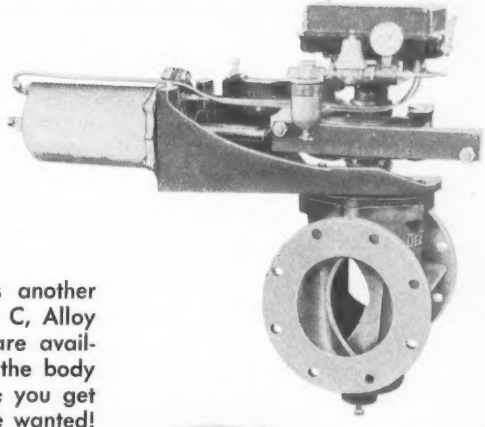
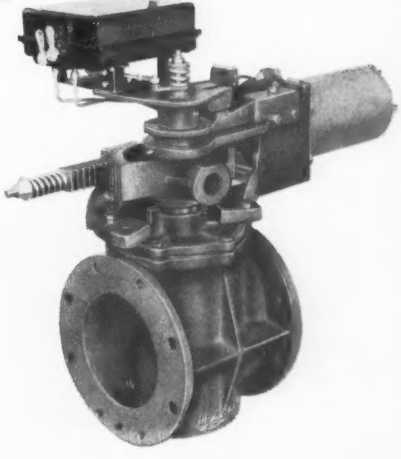
AUTOMATIC FLOW CONTROL with almost unlimited flow characteristics . . . with highest rangeability, capacity, accuracy . . . with absolutely dead-tight shut-off and leak-proof stem seal—that's the kind of complete CONTROL you get from every DeZurik Control Valve. Only these valves give you the original DeZurik Eccentric Action—friction-free, non-binding, positive positioning, unrestricted flow. And only these valves can be changed in throttling characteristic by simply changing a cam in the positioner. No dismantling, no shutdowns!



SUPERIOR CORROSION CONTROL on the toughest services is another feature of DeZurik Control Valves. Monel, Nickel, Hastelloy B or C, Alloy 20—these high alloys and many other resistant body-materials are available. You "customize" your DeZurik Control Valves with exactly the body and plug materials, the sizes and the operating units you require; you get precisely the flow control, corrosion control and cost control you've wanted!

Ask For Control Valve Bulletin 150



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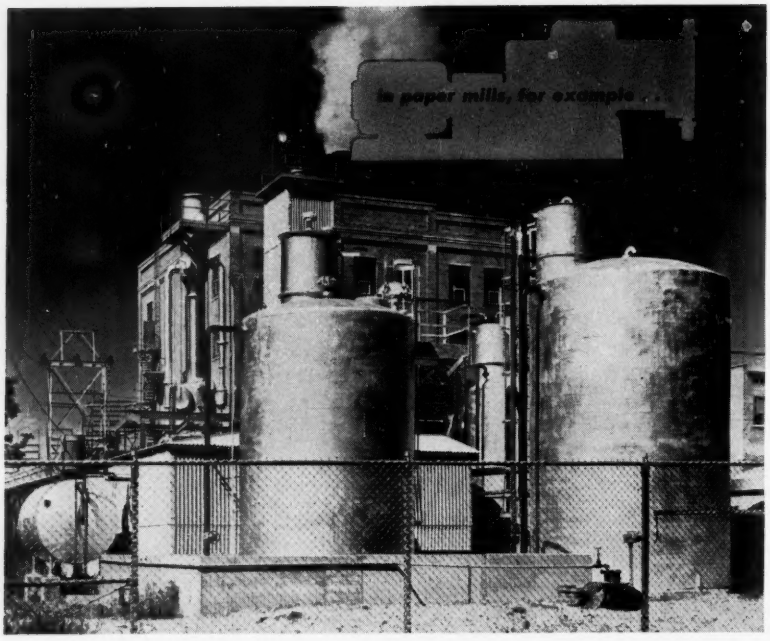

Pulsafeeder compounds chlorine dioxide bleach in perfect proportion without leakage

For Nekoosa-Edwards Paper Company, a special quintuplex Pulsafeeder provides continuous production of a bleaching compound that is too unstable to store. Each of the five heads is independently adjustable to meter out the proper proportion of water, sodium chlorate, sulphuric acid, and two additions of methanol. Result: a critically precise formulation of chlorine dioxide, with total output controlled by a single variable speed drive to keep pace with process rate. Never a drop of leakage . . . never a trace of corrosion . . . in over four years of steady use!

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withstands the hardest-to-handle materials you can feed into it . . .

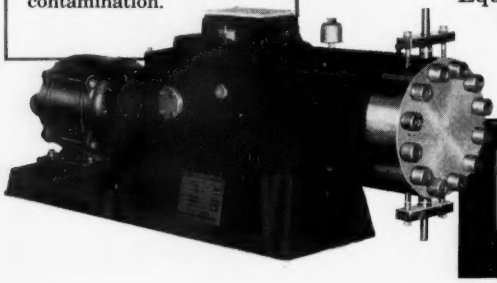
meters them at critically controlled flow rates . . .

never leaks a drop . . .

and completely seals pumping fluids from process materials so there can never be a trace of contamination.

The harder your materials are to handle, and the tighter your tolerances, the more you need a Pulsafeeder. Choose from today's most complete line—in flow rates from a few drops to 15.7 gallons per minute—with reagent heads resistant to any material you use.

WRITE for Catalog 59. Lapp Insulator Co., Inc. Process Equipment Division, 1120 Poplar Street, LeRoy, New York.



Lapp

termesh; two two-wing agitators orbit around a center four-wing unit. Charging-time loss is minimal with the use of interchangeable mixing bowls. Pressure or vacuum mixing is possible.—**The J. H. Day Co., Div. of The Cleveland Automatic Machine Co., Cincinnati.** **176D**

Motorized butterfly valve operates directly from a sealed electric power unit to minimize mounting space. High and low flow positions are set by limit switches. Available in 1-6-in. pipe sizes for use to 5 psi. — **The North American Mfg. Co., Cleveland.** **178A**

Plotting scale converts plain paper into a custom plot with logarithmic scales of any length, number of cycles, scale modulus or configuration. Plastic chart, 4 × 8 in., has 12 log cycles ranging from ¾ to 1 in., three linear scales and two triangular charts. It is punched for insertion in a 3-ring notebook, costs about $2.—**Technical Marketing Associates, Inc., Concord, Mass.** **178B**

Equipment Cost Indexes . . .

	Mar. 1961	June 1961
Industry		
Avg. of all	237.2	236.9
Process Industries		
Cement mfg.	231.3	230.9
Chemical	238.0	237.3
Clay products	224.8	224.4
Glass mfg.	224.7	224.0
Paint mfg.	229.7	229.4
Paper mfg.	229.3	228.6
Petroleum ind.	234.7	234.8
Rubber ind.	237.6	237.6
Process ind. avg.	235.9	235.2
Related Industries		
Elec. Power equip.	237.9	235.1
Mining, milling	239.4	238.7
Refrigerating	268.5	268.6
Steam power	224.9	225.0

Compiled quarterly by Marshall and Stevens, Los Angeles, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124-6 for method of obtaining index numbers; Mar. 6, 1961, pp. 115–116 for annual averages since 1913.

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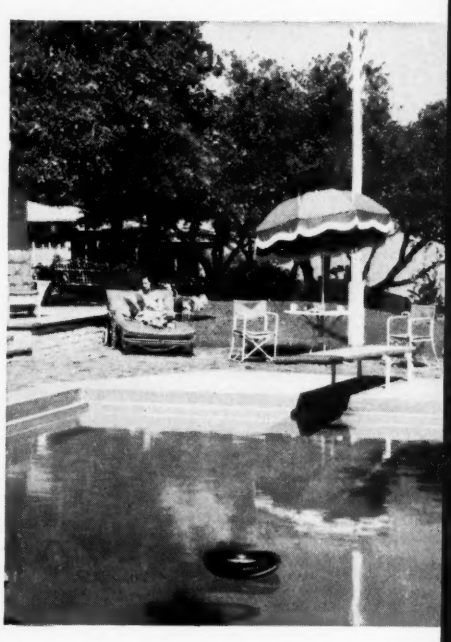

KEEP POOLS ATTRACTIVE—Swimming pools stay bright and attractive when they're protected with special paints containing Parlon® Hercules chlorinated natural rubber. With some 211,000 private pools in use today this is a big job—and another of the myriad ways Hercules chemicals are used to produce better performance in the products of others.

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In open position piston retracts, leaving entire body empty for FREE-FLOWING LIVE SAMPLE.
CLOSED
In closed position stainless steel piston fills whole interior of valve—extends to inner surface of vessel—therefore foreign material cannot gather in the body section.
Perfect sealing is assured by two compressible, replaceable Teflon rings.

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P1-317

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Technical Bookshelf

MORE ON GLASS

THE STRUCTURE OF GLASS. VOL. 2. BY VARIOUS AUTHORS. TRANSLATED FROM RUSSIAN. CONSULTANTS BUREAU, NEW YORK. 480 PAGES. $25.

REVIEWED BY S. S. WEIDENBAUM, CORNING GLASS WORKS, CORNING, N. Y.

Covering work on the structure of glass in the Soviet Union since 1953, this volume complements its predecessor, which presented work done before that time. The topics include general problems of the glassy state, silicate melt-mechanism of glass formation, optical properties and structure of glass, electrical properties of glasses, physicochemical properties of glasses and some special vitreous systems (semiconductor and sodium-borosilicate glasses).

The book attests to the considerable amount of work, much of it fundamental, being done on the above subjects in the Soviet Union. Receiving heavy attention are infrared spectroscopy and other optical and electrical methods, the chalcogenide glasses (which are a link between conventional silicate glasses and some organic polymers), and electrical conductivity of glass.

The study of the chemical composition of glass containing new elements is beginning to gain more prominence. Concerning the crystallite trend v.s. random-network theories of glass structure, the growing feeling is that the difference between these two is basically one of terminology.

Of significance to chemical engineers is concern about the effects of raw materials and impurities on the properties of glass, and the necessity for processing improvements in this area. (This matches an increasing awareness in the U. S. of the effect of premelting history on the final glass product.) Since many of the solids-handling operations are within the domain of chemical engineers, their opportunities in the glass field are becoming more evident. Also of interest to ChE's: the discussion of the polymeric structure of inorganic glasses.

Despite the references to the importance of the "Sitalls" (such as Corning's Pyroceram brand materials), the book contains no papers on this subject.

COST CUTTER

COST REDUCTION GUIDE FOR MANUFACTURING MANAGEMENT.

BY E. E. WYATT AND H. C. MORSE. HITCHCOCK PUBLISHING CO., WHEATON, ILL. 256 PAGES. $18.

The continuing profit squeeze in the CPI and most other industries has taken much of the novelty out of cost reduction; however, many companies' efforts in this field are still piecemeal rather than organized and systematic.

The authors (who as consultants have administered many a cost reduction program) feel that an organized program is a must, and the first section of their book is a good, clearly written guide to establishing such a program.

The second section gives detailed case histories of six cost reduction campaigns. The companies concerned had different weaknesses and problems so that each campaign needed special points of emphasis.

The third section consists of 1,200 questions, to enable a company to audit its entire operation, and come up with a profile of company strengths and weaknesses. Many of these questions are quite thought-provoking; some are on the academic side, but most are valuable.

A number of interesting exhibits make up the fourth section. Included are progress reports, newsletters, check lists, a poster showing 64 ways an hourly worker can cut waste, and another showing 142 ways a foreman can do so.

As you may have gathered by now, this is an ambitious book. It touches on almost every phase of plant management, as well as on some aspects of product design, marketing and financial control. While this means that only a few areas are covered in depth, the principles, suggestions and examples that are presented can give a determined, imaginative management plenty to work on.—HP

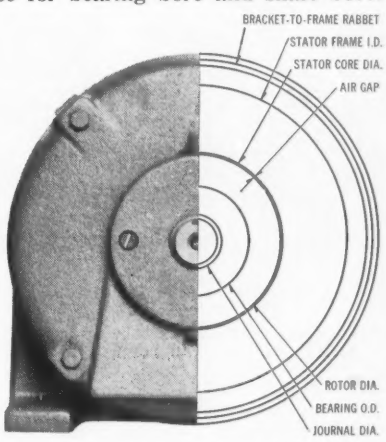
A MOTOR IS A SERIES OF CIRCLES

Checking bracket rabbet of an Elliott C-W Motor

The smooth, quiet, cool operation of Elliott Crocker-Wheeler motors is a direct result of the accuracy and concentricity of the "circles" that are its most important dimensions. Some of these circles are identified in the drawing below.

The bracket rabbet is a reference for bearing bore and shaft bore. Through matching jigs, the rabbets and bores of the stator are made accurately concentric with the bracket. Thus, when the motor is assembled, the series of concentric circles has been accurately established. With all parts in alignment, there is no preloading of bearings, air gap is uniform, noise is minimized, heat transfer expedited, smooth, trouble-free operation assured.

The highly-perfected, precision manufacturing processes by which Elliott achieves this vital concentricity are described by a booklet, *The Fine Art of Building Better Motors*. We will be happy to send you a copy. Contact nearest Elliott office, or write Crocker-Wheeler Division, Elliott Company, Jeannette, Pa.



Precise fit and concentricity of brackets to frame, frame to core, shaft to rotor and bearings, and bearings to brackets gives Elliott C-W Motors long life, trouble-free operation.

Elliott Crocker-Wheeler integral-hp a-c and d-c motors—from smallest to largest—are offered in all conventional enclosures and modifications; with insulation to suit the application, including EPA-SEAL the epoxy insulation used where conditions are very severe. W1-4

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BOOKSHELF . . .

In Rapid Review

Symposium on Chemical Process Hazards with Special Reference to Plant Design. The Institution of Chemical Engineers, 16 Belgrave Square, London, S.W. 1. 117 pages. $7.00. The 13 papers presented at this March 1960 symposium are reproduced here, as are the discussions held at the end of each of the four sessions. The papers cover not only problems associated with hazardous processes in general, but also those linked to specific products, such as hydrofluoric acid, acetylene, ethylene oxide and toxic phosphorus compounds.

Rare Metals Handbook. 2nd ed. Ed. by C. A. Hampel. Reinhold. 715 pages. $20. A more-accurate title for this excellent source book might be "Less-Common Metals." Metals made in tonnage quantities such as chromium and cadmium are included as well as those normally considered rare. In all, 55 metals are covered. A typical chapter includes a historical introduction, plus sections on occurrence, extractive metallurgy, physical and chemical properties, economics, applications and fabrication, toxicity and health hazards, and also an extensive bibliography.

Name Index of Organic Reactions. By J. E. Gowan and T. S. Wheeler. Interscience. 293 pages. $8.50. Almost 750 organic reactions are diagrammed and briefly described in an alphabetic format, items being listed by the name of the reaction's discoverer (e.g., "Johnson synthesis of 2-thiohydantoins," "Kandakov olefin reaction," etc.). Copiously indexed and cross-referenced, with original sources meticulously cited, the volume is a windfall for all frustrated journal readers who tire easily of finding obscure organic reactions referred to only as "the "Brandt synthesis" or "Sabatier reduction."

More New Books

Information Retrieval and Machine Translation. Vol. 3, part 2. Ed. by A. Kent. Interscience. Pages 687-1376. $25.

Compressed Air and Gas Handbook. 3rd ed. Compressed Air and Gas Institute. 122 E. 42nd St., N. Y. 17, N. Y. 592 pages. $8.

Handbook of Fluid Dynamics. Ed. by V. L. Streeter. McGraw-Hill. 1,240 pages. $24.

The Plasma State. By E. J. Hellund. Reinhold. 197 pages. $6.50.

Investigations of Rates and Mechanisms of Reactions. Part 1. Ed. by S. L. Friess, E. S. Lewis and A. Weissberger. Interscience. 702 pages. $23.50.

Toms River Chemical Corporation's manufacturing complex includes five plants, producing (1) vat dyes, (2) azo dyes, (3) epoxy resins, (4) anthraquinone, and (5) epichlorohydrin

Teamwork Proves the Best Investment in Building This Giant Chemical Complex

Shown above, as they look today, are the manufacturing facilities of Toms River Chemical Corporation* in New Jersey. Once a single vat dye plant, the project has grown into a multi-million-dollar complex of five plants—producing azo dyes, Araldite® epoxy resins, anthraquinone, and epichlorohydrin, as well as vat dyes.

The successful completion of this undertaking, like many others in various parts of the world, was largely the result of Kellogg and client working closely as a team. At Toms River, this teamwork started in 1955 when Kellogg was assigned full responsibility for a new anthraquinone plant, and continued until 1961—when the last of the four new plants went into operation. Throughout this long association, Kellogg functioned virtually as an arm of Toms River Chemical Corporation in engineering, procurement, and construction. In these three areas, Kellogg and TRC specialists pooled their experience and technical know-how to execute best the capital investment for each plant.

Chemical companies interested in expanding their own manufacturing facilities are invited to write for the current 12-page Kelloggram which describes the Toms River chemical complex in detail.

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*Toms River Chemical Corporation's parent companies are CIBA Limited, J.R. Geigy, S.A., and Sandoz Ltd.

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PRO & CON . . .

continued from page 7

suggestion seriously, especially in connection with your sensible editorial of 1952.

JOHN E. ULLMANN
Stevens Institute of Technology
Hoboken, N. J.

► *As to Prof. Ullmann's closing comment, our policy is to keep these columns open to the expression of readers' opinions, whether we agree with them or not.*—ED.

Pro: Distinctive Symbols

Sir:

Your Apr. 3 article entitled "The Status of Status" (pp. 161-2) was well marked for my attention when it came through normal distribution. You see, I wear Wellington boots, and have for almost ten years.

If your artist was thinking of me, he did not get the idea from a civil engineer in the field. For ten years I worked around foundries and could never get accustomed to the potential of hot iron inside an oxford, which might take too long to remove. High (work) shoes were not the answer as they were too hot. The final answer was a Wellington dress boot which was easy to remove, cooler than a high shoe, and with the trousers over the outside did a fair job of keep-

ing hot splashed metal and dirt away from the tender feet.

When I moved into the electrical industry, there really was no longer an excuse to wear these boots. I stuck with them, though, as you would an old friend. Yes, I do believe I managed to maintain a status in this manner, but I believe the title applied was "character." Oh well, "engineer" and "character" are somewhat synonymous —sometimes.

GEORGE A. MEYER
Stackpole Carbon Co.
St. Marys, Pa.
P.S.—How about cowboy shirts and string ties?

Beryllium Clarified

Sir:

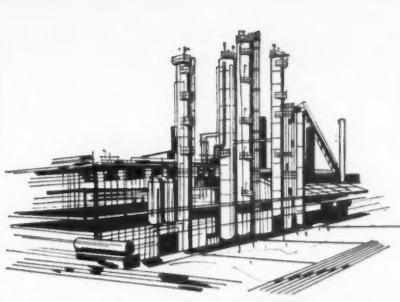
In your May 1 *Chementator* (p. 32) you had a story on beryllium oxide and beryllium metal. I note certain inaccuracies which perhaps you might wish to correct.

You refer to a beryllium consumption of 30,000 tons in 1962. This projection is unrealistic. Perhaps you may have meant beryl ore or equivalent, and this, of course, is a different matter. The U. S. beryllium industry consumed approximately 9,500 tons of beryl ore in 1960. And the ore averages about 11% beryllium oxide.

With reference to the selling price for beryllium oxide shown in your article of $3-4/lb., this is not correct. The only beryllium oxide grade being sold in large quantities is one of our products that sells for $17-22/lb. This grade of beryllium oxide has no relationship to the impure plant grade of beryllium oxide used in production of beryllium-copper master alloy. It is not necessarily true, therefore, that "there is a strong incentive for an oxide producer to investigate metal production," as you concluded.

N. W. BASS
Brush Beryllium Corp.
Cleveland, Ohio

► *Thanks to Mr. Bass for clarifying our confusion of beryllium with beryl and for his expression of opinion on the question of metal production.*—ED.



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With 25 times the tensile strength of Teflon resin packings, Super-Lon is the industries newest and most glamorous all-purpose Chemical Packing. Super-Lon has all the known advantages of Teflon *plus* 50,000 psi tensile strength contrasted to 2,000 psi limitations in older Teflon Resin styles. Here at last is a pure, strong Teflon fibre packing which runs cool on the shaft, stands heat to 550°F, and incorporates the lubrication advantages of regular Braided Packings.

Super-Lon is inert to all chemicals (except molten alkali metals), is braided for softness and resilience and, treated with special high-shaft-speed lubricants resistant to corrosive destruction. Chesterton Super-Lon, made of Teflon fibre, is your answer to the toughest corrosive problems. It has proven that it cuts maintenance costs spectacularly. Write for further information. A. W. CHESTERTON COMPANY, Everett 49, Mass. America's Oldest Manufacturer of Mechanical Packings.

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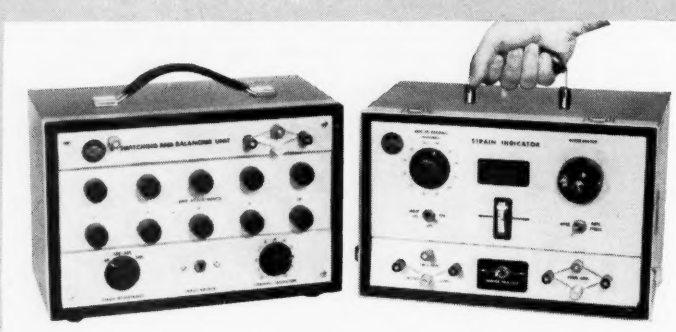

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Manufacturers' Literature

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Pumps, fans, compressors	200
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Chemicals

Acrylic Monomers.....Literature and samples are available for assistance in planning facilities for storing and handling of acrylic monomers at lowest cost.
155 *Rohm & Haas

Alcohols.....Latest in the series is hexyl alcohol. Specifications on the full line of alcohols or other high quality chemicals is available on request.
151 *Enjay Chemical Co.

Biochemicals.....A new reference guide and price list for research biochemicals, No. 127 contains a new product section showing 179 new products.
186A *Mann Research Laboratories

Chemicals.....Armoflo compounds are described in a new, revised edition of "Armoflo- Armour Anti-dusting & Anti-caking Chemicals" which is available.
18-19 *Armour Industrial Chemical Co.

Coal Tar Chemicals.....A folder, Form P.D. 350, includes coal-tar chemicals and petrochemicals. Some are commercially new & other are long established.
33-36 *Allied Chemical, Plastics Div.

Hydrocyanic Acid.....Pamphlet SD-167 describes properties and details engineering control of health, fire and explosion hazards of chemical.
186B *Manufacturing Chemists' Assn.

Lubricants.....20-page booklet offers a collection of information on the basic concept of molybdenum disulfide additives used to enhance temperature capabilities of lubricants.
186C Hercules Packing Corp.

Onamine RO.....Bulletin describes cationic cyclic tertiary amine with powerful surface adsorption characteristics and exceptional stability
186D Onyx Chemical Corp.

Plastic.....Teflon is easily bondable to other materials and to itself with commercial adhesives. Complete Teflon service to help improve design & increase reliability.
182 *Raybestos-Manhattan, Inc.

Polyester Resins.....Data on polyester and acrylic-modified polyester resins given in a group of booklets that discusses chemical and physical properties.
187A Rohm & Haas Co.

Resins.....Booklet tells how Velsicols hydrocarbon resins help to achieve optimum tack, viscosity and adhesion due to their elastomer compatibility and low oxygen susceptibility.
187B Velsicol Chemical Corp.

Silicones.....8-page production-engineering guide to the silicones most useful in the production of rubber and plastic materials and parts.
187C Dow Corning Corp.

Sodium Borohydride.....SWS is a stable, aqueous caustic solution of sodium borohydride. It is easy & safe to handle & use in standard equipment. Complete information.
67 *Metal Hydrides Inc.

Tetrahydrofurfuryl Alcohol.....The physical properties, chemistry and applications of tetrahydrofurfuryl alcohol are described in Bulletin 206-A.
66 *Quaker Oats Co.

Construction Materials

Block Insulation.....PV Supertemp block insulation is highly efficient and practically dustless. It is easily cut to fit irregular areas with no special tools.
96 *Eagle-Picher Company

Cement.....Supertite is a resinous grout cement and is absolutely immune to corrosive effects of food acids, sugars & syrups. Information and technical data.
159 *Amercoat Corp.

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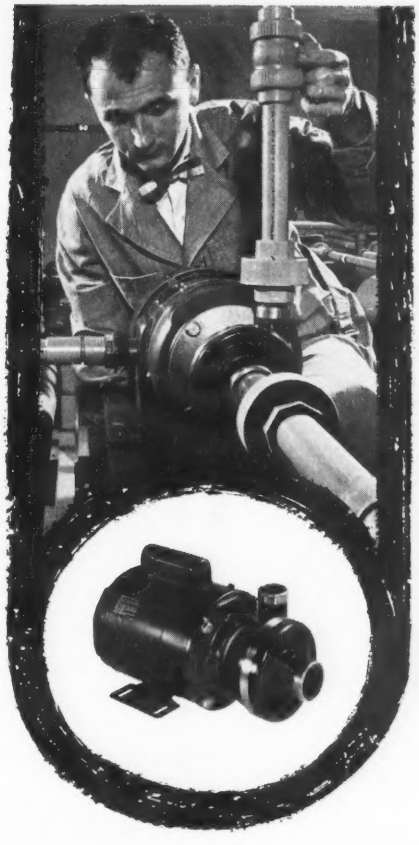

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Specifically engineered for the chemical processing industries, Chemtrol's molded Penton plastic pump has the broadest corrosion resistance spectrum of any centrifugal pump on the market today . . . a pump unmatched for corrosive conditions.

Now you are able to pump most acids, alkalies, salts and solvents . . . many at elevated temperature without change of pump parts.

Various sizes of enclosed-type or semi-open type impellers with optimum contour design . . . pressure balanced to give low thrust loads. And the positive mechanical seal, operating at near suction pressures, is cooled by the fluid being pumped.

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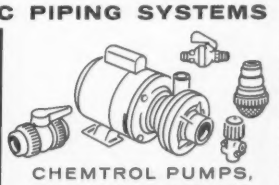

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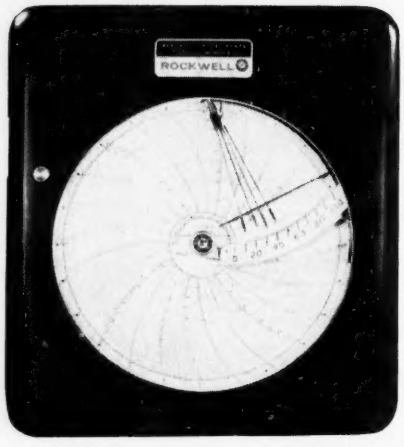
MP-12 Analogger combines continuous integrator with 3-15 psig square root extracting receiver

Rockwell-Republic's MP-12 Analogger is a one-to-four pen, 12″ circular chart pneumatic receiver recorder. It offers a 3–15 psig square root extracting receiver and a continuous integrator, making it ideal for flow measurement.

The receiver converts a 3–15 psig differential pressure signal to a linear flow record. The integrator, based on Rockwell-Republic's time-proven watt-hour meter principle, catches swings and integrates all of the flow to provide an up-to-the-moment total.



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The MP-12 Analogger's quadrant design permits a wide variety of recording and integrating combinations to meet your exact needs. For example, up to four completely unitized plug-in receivers may be quickly and easily installed for recording process variables. Or, Rockwell-Republic continuous integrators may be employed in either or both of the upper quadrants.

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For more information about the MP-12 Analogger and other Rockwell-Republic instruments and controls, just mail the coupon. RF-27

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LITERATURE . . .

Coatings & Enamels.....Imlar vinyl-mastic coatings & vinyl enamels have been developed for use where metal protective finishes are not recommended. Bulletin.
71b *E. I. DuPont de Nemours

Epoxy Enamels.....Corlar epoxy chemical-resistant enamels have been developed for surfaces subject to severe corrosive conditions. Technical bulletin is offered.
71a *E. I. DuPont de Nemours

Gallium.....exists in aluminous ores of the bauxite type. It is used as a sealant, shows promise as a heat transfer medium. Information is offered on applications.
31 *Aluminum Co. of America

Mechanical Packings.....A full line of mechanical packings such as high pressure asbestos, rotary pump packings, valve packings and many others.
169 *Belmont Packing & Rubber Co.

Metals.....Booklet describes the various solid & clad base metals, solid & clad precious metals, thermostat metals, industrial metals & electrical contacts.
188A Metals & Controls, Inc.

Packing.....Super-Lon is inert to all chemicals except molten alkali metals and is braided for softness and resilience. Further information is offered.
185a *A. W. Chesterton Co.

Plastic Sheeting.....New PVC Hi-Temp is the first polyvinyl dichloride sheet that can withstand boiling temperatures. Makes possible a wide range of ductwork & tanks.
173 *Seiberling Rubber Company

Platinum Metals.....in all shapes and forms . . . sheet, strip, foil, wire, tubing, gauze, salts & chemicals. Clads & Composites also available in many forms. Bulletin P-6.
143 *J. Bishop & Co.

Protective Coatings.....for steel tank linings, concrete floors, tank cars, etc. Selection of coatings & other Plasite products covered in booklet.
L214 *Wisconsin Protective Coating Co.

Refractories.....to answer your specific needs. Descriptive brochures may be had upon request to help in the selection of refractory materials for your job.
24-25 *Carborundum Co.

Silicon Coatings.....Coatings formulated with silicon resins are more durable. More specific information on silicone resins & copolymers is available.
161 *Dow Corning Corp.

Steel.....Four papers which discuss continuing advances in strength levels, product forms and design applications of constructional steels given in 59-page booklet.
188B U. S. Steel Corp.

Synthetic Rubber.....A booklet that contains technical data about viton synthetic rubber and its many applications is available on request.
163 *E. I. DuPont de Nemours

Tank Linings.....New Gar-Line Penton linings offer high-temperature protection against corrosion. Data on Penton; information on tank linings.
98 *Garlock Inc.

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FREE REPRINT: Check here ☐ for your file copy of this issue's free reprint. (p. 125) FC 68

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Use either of these two postcards for catalogs . . . for more information on equipment . . . on materials . . . on advertised items . . . for helpful reprints of editorial articles. Be sure to fill out the other side of cards.

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93-94b—All-Chem Rotary Pumps
93-94c—Minilab Rotary Pumps
93-94d—Gearchem Gear Pumps
93-94e—Centri-Chem Centrifugal Pumps
93-94f—Portable Pumping Units
93-94g—Gear-Vac Valves
93-94h—Chemical Dispensing Valves

170a—RJ Filter Bulletin
170b—Dust Separators
170c—Industrial Fans
170d—Reverse Jet Dust Filter Facts
170e—Rotary Valves
170f—Schlitz Defeats Dust
170g—Efficient Dust Snatchers
170h—Unit Dust Collectors
170i—Heavy Duty Dust Separator

176a—Thermocouples
176b—Thermocouple Assemblies
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188b—VRC Ratio Computer
188c—Control Valves
188d—Desuperheating & Pressure Reducing Systems
188e—Electronic Control Systems
188f—Process Transmitters
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For a new reprinting of Chemical Engineering's cost estimating articles; see p. 202

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***Don't forget to check the Free Reprint box for your extra copy of this issue's reprint feature (p. 125)**

Here a drain elbow and a reducer form the "bodies" for DURABLA *Basic-Check* Units. As indicated, they will operate in any position . . . can be used with most standard fittings.

Put this check valve ANYWHERE in existing piping

The DURABLA *Basic-Check* Unit* is the most convenient check valve you can use, since it installs in existing piping anywhere you please. Combined with almost any standard fitting—like the drain elbow or reducer shown—it becomes a complete check valve suitable for the widest variety of services.

It operates freely in any position. Thus it can be installed without changes in existing lines, or costly "positioning" in new installations. Means cleaner designs, too, because there are no demands on space.

These stainless-steel valve units will handle practically any liquid, gas or air . . . come in seven standard line sizes from ⅜" to 2".

For full details, send for booklet CE-81.

DURABLA MANUFACTURING CO.
114 Liberty Street, New York 6, New York

DURABLA®

Manufacturers of DURABLA sheet packing, gaskets and pump valves.

*The DURABLA *Basic-Check*® Brand Unit is covered by U. S. Patent No. 2,649,277 and Canadian Patent No. 549,618.

DM-42

LITERATURE . . .

Wire Cloth.....Whatever metal or alloy needed in any size or quantity to the closest tolerances. High mesh counts are featured. A catalog is available.
92 *Cambridge Wire Cloth Co.

Electrical & Mechanical

Gas Turbines.....as a dependable power source for generators & compressors, as a propulsion unit for high-speed boats & in other applications. Information about all types.
42 *Solar Aircraft Co.

Lighting Fixtures.....Details on mercury vapor explosion-proof fixtures for hazardous areas, as well as a full complement of accessories including mountings, reflectors, etc.
1 *Appelton Electric Co.

Pump Drives & Accessories.....A new bulletin, PD-760 describes all standard drives for AllChem, Garchem, Minilab and Centri-Chem pumps. Also features new channel & cast drip rim bases & other accessories.
93-94a *Eco Engineering Co.

Motors.....Key manufacturing operations employed in maintaining the required close tolerances are described in "The Fine Art of Building Better Motors".
181 *Elliott Company

Motor Control Center.....features reliability, versatility, economy, strength and safety. Exclusive plug-in terminal blocks cut installation time. Facts.
149 *Allis-Chalmers

Motors, Tube Ventilated.....provide power to move petroleum to market. Also used as drive for big fans, blowers and compressors or any heavy-duty application.
102 *Wagner Electric Corp.

Speed Control.....Ampli-Speed has nearly stepless speed change & gives speed regulation within ± 2%. Illustrated publication No. 243 tells how it works.
171 *Electric Machinery Mfg. Co.

Thermocouples.....Cono-Clad mineral insulated thermocouples eliminate corrosion & contamination potential Facts are contained in Bulletin 300 which is offered.
176a *Conax Corp.

Turbines.....built to customers' specifications, including API and NEMA standards. A complete range from 1 hp to 250 hp. Further information in Catalog 200.
45 *Coppus Engineering Corp.

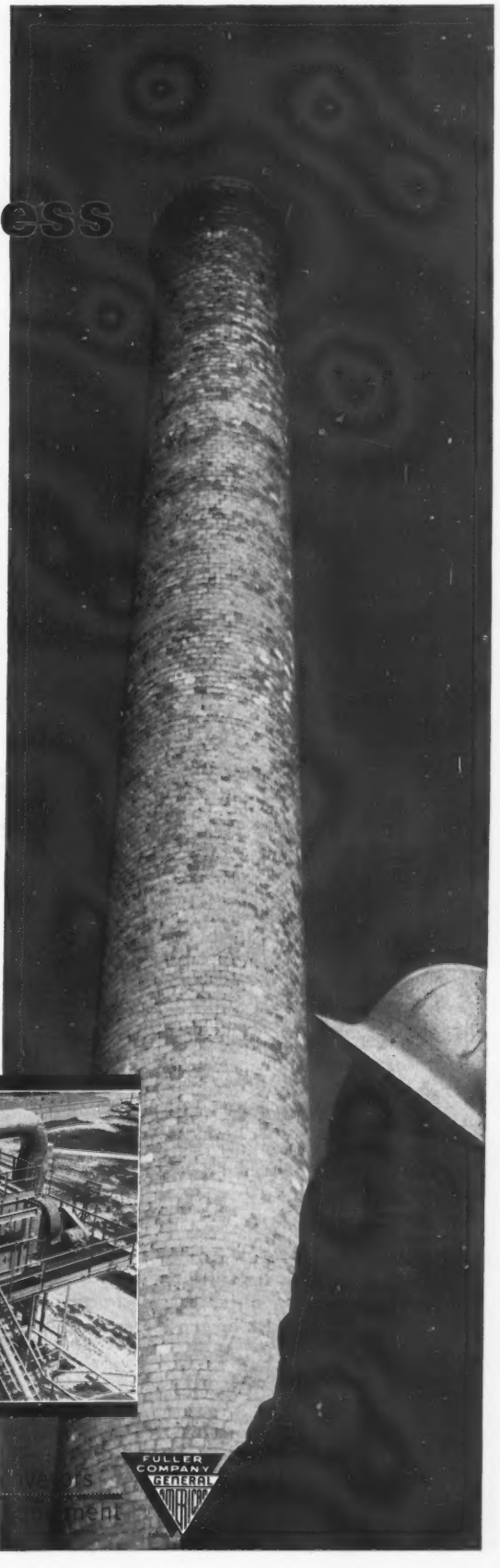
Handling & Packaging

Automatic Scales.....Technical bulletin on how automatic bagging and proportioning scales are promoting good housekeeping, controling quality, etc.
175 *Richardson Scale Co.

Liquid Loaders.....Catalog describes and illustrates seven basic types of liquid loaders and shows which to use where. Includes prices and technical data.
192A OPW-Jordan Corp.

* From advertisement, this issue

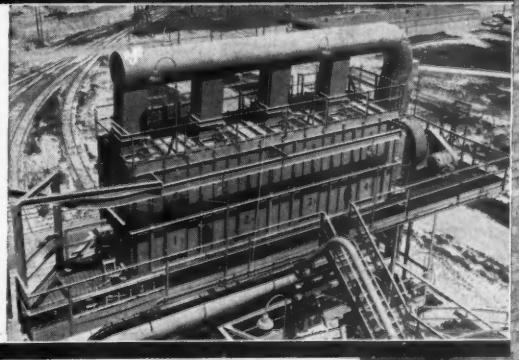
is your company's progress showing?



Not too many years ago, smoke clouds over a plant meant prosperity. Today, with the flood of public opinion against dirty air, such a sign has other connotations: (1) the plant is out-of-date; (2) the plant is probably inefficient and wasteful; (3) the owners are postponing their civic duties.

Nowadays, *clean* stacks are a sign of good management and an up-to-date plant. Many companies are keeping stacks clean by collecting dust and fume with a Dracco Dust Control system. Dracco installations use cloth filter bags—made from fiber glass, natural or synthetic fabrics—to provide high-efficiency collection of all visible particles. Each system is custom-engineered to a particular plant layout, and to the characteristics of the dust or fume to be collected. Nuisance dusts can be controlled and discarded . . . valuable dusts can be returned to process.

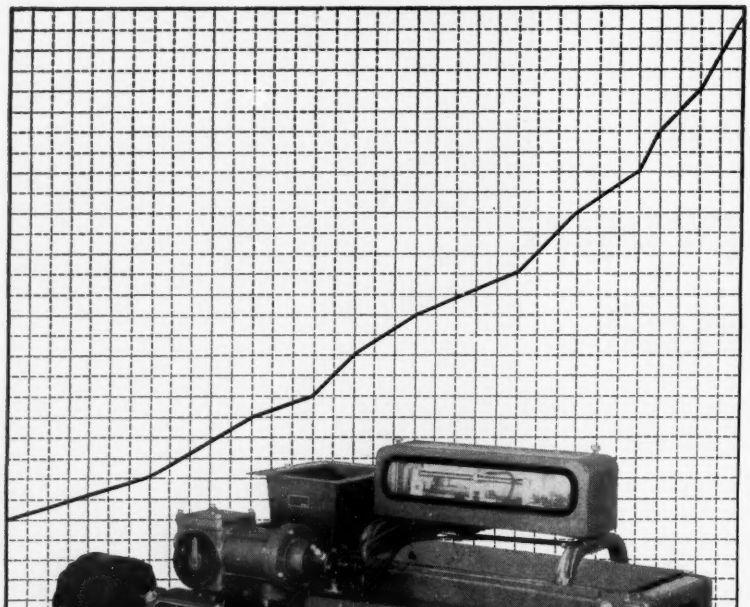
Take a look at your sky. If dirty air is one of your by-products, call a halt by calling Dracco Division of Fuller Company, Harvard Avenue and East 116th Street, Cleveland 5, Ohio.



The use of glass cloth extends the application of Dracco bag-type filters to temperatures as high as 600°F., and sonic cleaning reduces maintenance costs. Higher temperatures are possible with auxiliary cooling. Dracco cloth filtration provides highest efficiency collection of dust particles even in the sub-micron range.

DRACCO *airstream* conveyors dust control equipment

FULLER COMPANY GENERAL SUPERVISION



IMPROVE YOUR YIELD WITH 99% FEEDING ACCURACY...

THE W&T MERCHEN FEEDER

If you need accurate control of dry, free flowing materials to keep process yields high, count on the W&T Merchen Feeder. The Merchen controls dry flow to a hairsbreadth, hour after hour.

Pick any minute any time in your run. Pick one at high capacity, another at low capacity. The Merchen holds accuracy to ±1% from minute to minute . . . stretches the minutes into hours of precise feeding. You solve tough feeding and continuous-blending problems, get sure quality control.

Accuracy comes from sensitivity. And a change of just one ounce in a 63-pound belt load actuates the Merchen's control mechanism. It responds instantly. Accuracy is assured.

This versatile Wallace & Tiernan Feeder has other advantages: It's a straight gravimetric feeder; it feeds and controls other equipment; or it feeds in proportion to any 3-15 psi signal. Corrosion-resistant construction lets it handle most chemicals. And even the largest model occupies less than 3 x 5 feet of floor space.

For more information, write Dept. M-64.29.

WALLACE & TIERNAN INC.
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

LITERATURE . . .

Loader.....Loads can palletized or stacked in any pattern, also put into warehouse storage. Literature & engineering details are available.
B198 *Power-Curve Conveyor Co.

Loading Arms..... Bulletin 1-61 is available on request for complete information on a series of loading arms that measure up on every count.
8-9 *Chiksan Company

Pneumatic Conveyors.....Bulletin describes compact positive and negative pressure pneumatic systems for car, truck or bin unloading in both stationary and portable units.
194A Sprout, Waldron & Co., Inc.

Tractor Shovels.....Michigan Tractor Shovels are available in a wide variety of models for excellent performance and economy. Further information is available.
101 *Clark Equipment Co.

Heating & Cooling

Heat Exchanger.....Stainless steel extended surface heat exchangers can be designed to your performance specifications. Further information is offered.
167 *Marlo Coil Co.

Heat Exchanger.....A detailed description of Karbate impervious graphite heat exchangers Type CFB is presented in a new, 8-page Catalog Section S-6813.
141 *National Carbon Co.

Heat Exchangers.....Helpful information on the design and fabrication of heat exchangers and pressure vessels is contained in Bulletins HE and CI which are offered.
4 *Downington Iron Works, Inc.

Heat Transfer.....Platecoil provides a packaged answer to many heat transfer problems, avoiding costly engineering and fabricating of pipe coils. Bulletin P61.
91 *Platecoil Div., Tranter Mfg. Inc.

Heat Transfer Equipment.....An illustrate brochure, personnel data sheet and customer references are available for information on the full line of heat transfer equipment.
164 *Krueger Engineering & Mfg. Co.

Liquid Chilling Packages.....with automatic capacity control for economical operation. Details on the water-cooled 30A and the condenserless 30B.
168 *Carrier Air Conditioning Co.

Plate Heat Exchanger.....Case history brochure details actual processing applications while catalog describes models ranging from 500 to 500,000 lbs/hr. capacity.
16-17 *De Laval Separator Co.

Rotating Seal.....There is a standard type and size Rotary Union for heating & cooling any revolving roll or drum. Pipe sizes ¼" through 5". Bulletin 700.
R214 *Perfecting Service Co.

Steam Traps.....Series 30 is the steam trap for peak efficiency. Series 130 combines a Series 30 trap, a strainer & blow-down valve. New bulletin T-1743-B offered.
47 *Yarnall-Waring Co.

* From advertisement, this issue

Instruments & Controls

Analogger.....The MP-12 analogger combines continuous integrator with 3-15 psig square root extracting receiver. Literature is available for further information.
188a *Republic Flow Meters Co.

Automatic Load Control.....New Mikro-Monitor offers increased output, constant operation and virtually no supervision. Details are available on request.
83 *Mikro Products

Computer.....Recomp 111 is the newest low-cost compact digital Computer. Full information is available on its proven performance and quality.
184 *Autonetics Div. of N. American

Controls.....to control or indicate the pressure or temperature of gases, fluids or electrical energy. A wide variety of instruments such as transducers, etc.
139 *American–Standard

Gages.....Bulletin describes V5 gages for indicating drafts, pressure, differential gas pressure and temperature and pneumatic impulses from transmitters.
195A Republic Flow Meters Co.

Liquid Level Controls.....Floatless Electrode type are unaffected by acids or caustics. Standard 2 & 3 pole units listed by U/L. Complete specifications in 32–pg. Catalog.
T196 *Charles F. Warrick Co.

Meters.....A 28-page technical bulletin lists liquids, helps pick proper sizes and features meters 2 to 2000 gpm. This Bulletin 566Q is available on request.
99 *Neptune Meter Co.

Potentiometers.....Complete line of new miniaturized pressure potentiometers available in ranges from 0-10 to 0-5000 psia described in bulletin 1045.
195B Trans-Sonics, Inc.

Strain Indicator.....This digital strain indicator sets a new standard for ease of operation and readout. Data sheets are available for further details.
186 *Baldwin-Lima-Hamilton

Temperature Transmitter.....offers thermal system options with ranges from 125 deg. to 1,000 deg. F. Details on this new transmitter in S630-1 on request.
147 *Minneapolis-Honeywell

Transmitters.....Descriptive literature is available for details on d/p Cell transmitters in both pneumatic or electronic models for your system.
65 Foxboro Company

Pipe, Fittings & Valves

Ball Valve.....This PVC ball valve features full port opening, single-end external adjustment, rugged construction and Teflon seat rings. Bulletin 195 is offered.
12-13 *Walworth Co.

* From advertisement, this issue

You Won't Believe It's Not Anchored

Wallace & Tiernan's new Heavy Duty Metering Pump operates so smoothly there's no strain, no twisting or wrenching of parts. Vibration's scarcely noticeable — even when the pump's not fastened down.

This effortless action springs from a new idea in metering pump design: Balanced eccentrics drive the plunger and connecting rod in a straight line. There are no rocker arms.

This straight-line transmission of forces eliminates cantilever loads. Driving forces are absorbed by two heavy ball bearings in the gear case. The tendency to twist components loose from the base is gone. Perfect alignment, lifetime accuracy, and far less maintenance are assured.

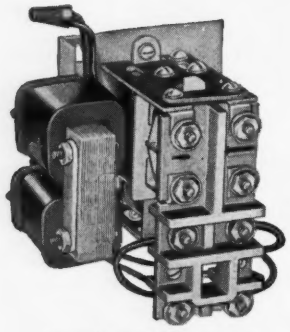
The cancelling eccentrics, used in both stop- and run-adjust models, make stroke-length adjustment responsive and convenient — especially for automatic control. For safety, the drive mechanism is completely enclosed; for long life, it's force-feed lubricated.

All job-proportioned W&T Metering Pumps, Series 200, 400, and 600, have the same efficient design. Capacities range from 0.065 gph vs 4000 psi to 4050 gph vs 170 psi.

For other helpful features, write Dept. L-6.29

WALLACE & TIERNAN INC.
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

WARRICK
Floatless, Electrode Type
LIQUID LEVEL CONTROLS



Two pole control shown above

Write for 32-page Catalog which gives complete specifications

Special controls to custom requirements

give you all these advantages!

No moving parts in the liquid • Easy to install • No adjustments necessary • Unaffected by acids or caustics • Unaffected by pressure or temperature • Standard 2&3 pole unit listed by U/L

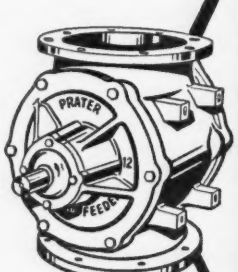
YOU CAN USE OUR CONTROLS FOR:

- Single & Multiple pumps
- Motor & solenoid valves
- High & low cutoffs, & alarms
- Condensate contamination
- Storage tanks
- Volumetric Metering
- Waste sumps

Dept. 12

CHARLES F. WARRICK COMPANY
1961 W. Eleven-Mile Road
Berkley, Michigan
Telephone JOrdan 4-6667

PRATER ROTARY AIRLOCKS



SEND YOUR AIRLOCK FEEDER PROBLEMS TO PRATER

Prater foremost builders of airlock feeders

PRATER PULVERIZER COMPANY
1517 South 55th Court • Chicago 50, Illinois

LITERATURE . . .

Ball Valves.....feature compact design, rotating seats to distribute wear, no bonnets or glands and they are sealed-for-life. Available in a wide range of sizes & pressurs.
77 *Cameron Iron Works, Inc.

Butterfly Valves.....Bulletin describes new designs in rubber seat butterfly valves and covers models from 3 to 144 inches for pressures from vacuum to 150 psi.
196A Henry Pratt Co.

Connectors.....A general catalog describing the line of pressure vessel connections available in detail may be had upon request to help solve problems.
T199 *Lenape Hydraulic Press. & Forg.

Control Valves.....16-page booklet gives details on construction and operation of single-seated, splitbody valve plus valuable valve sizing formulae.
196B Conoflow Corp.

Control Valves.....with an extremely high rangeability, providing a wider control range. Complete story available in Bulletin No. 150.
177 *DeZurik Corporation

Diaphragms.....Bulletin lists approximately 1200 standard sizes of rolling diaphragms in bore-sizes from 0.31 to 12.17 inches for strokes from 0.020 to 14.98 inches.
196C Bellofram Corp.

Fittings, Flanges & Unions.....Folder PF-2 contains complete data on quantities & weights of the items as packaged in various sizes of cartons.
110 *Henry Vogt Machine Co.

Flexible Hose.....Bulletin covers flexible metal hose designed for gravity or pneumatic transfer of grains and bulk materials where abrasion and corrosion resistance is required.
196D Universal Metal Hose Co.

Flexible Joints.....4-page catalog on flexible ball joints for handling liquid oxygen, liquid methane and other cryogenic liquids includes specifying information.
196E Barco Manufacturing Co.

Gate Valves.....Cast steel gate valves are made in regular and special compositions to match exact operating conditions. More detailed information is available.
48 *Darling Valve & Mfg. Co.

Globe Valves.....feature less corrosion attack because of elimination of cavity between stem and disc. Full information is to be found in Bulletin #7 which is available.
L200 *Alloy Steel Products Co.

Pipe, Pyrex.....comes in all standard sizes and fittings. You can see through the pipe wall into the flow area. Further information in Bulletin PE-3.
100 *Corning Glass Works

Self-Sealing Couplings.....20-page booklet gives general information and discusses basic applications possible with self-sealing couplings.
196F Aeroquip Corp.

Spray Nozzles.....Fulljet nozzles for multiple nozzle applications. The latest design in spraying systems square & circular spray patterns. Bul. 105 & Cat. 24.
T202 *Spraying Systems Co.

* From advertisement, this issue

Tubing.....Job-matched stainless and alloy steel pressure tubing raises heat transfer efficiency. Details are contained in Bulletin T-417 which is available.
44 *Babcock & Wilcox, Co.

Valve.....Sampling valves assure perfect sealing by two compressible replaceable Teflon rings. A new catalog page is available for further information.
T180 *Strahman Valves, Inc.

Valve, Diaphragm.....Packless diaphragm valve is ideal for instrument air and other gas and liquid services. Complete date on this low cost, high performance valve is offered.
T197 *G. W. Dahl Co., Inc.

Valves.....8-page bulletin describes and illustrates high pressure valves in three basic types, globe, check and relief, for pressures from 3000 to 6000 psi.
197A Farrel-Birmingham Co. Inc.

Valves.....16-page catalog presents specifications and characteristics of companies complete industrial Flo-Ball valve line with illustrations.
197B Hydromatics, Inc.

Valves.....Forged steel valves are available on all lines up to 2 in. Designed to meet control requirements with minimum replacement & Maintenance. Information.
59 *Ohio Injector Co.

Valves.....Rockwell-Nordstrom valves seal tight. They live longer and save money in valve replacement. Cost no more than ordinary valves. Bulletin V-217 is available.
43 *Rockwell Mfg. Co.

Valves, Check.....Basic-Check unit is the simplest check valve you can use with tanks. Design simplicity assures long service life. Information in Bulletin CE-81.
192 *Durabla Mfg. Co.

Valves, Stainless Steel.....All the features of these stainless steel valves are covered in the Stainless Steel Catalog No. 59SS which is available on request.
51 *Jenkins Bros.

Process Equipment

Agitators.....4-page bulletin 230 describes three basic styles of side entering agitators through 40 hp, gear and belt drive and includes diagrams.
197C Chemineer, Inc.

Air Filter.....Bulletin describes filter that removes condensed moisture and oil, and pipe scale from compressed air lines in two stage cleaning cycle.
197D R. P. Adams Co., Inc.

Air Separators.....offer precise separation and improve screening. Increase 40 to 400 mesh output as much as 300%. For further information Bul. 087 is offered.
R200 *Sturtevant Mill Co.

Blender.....Rota-Cone with agita- for blends lumpy, caker, balled and fibrous materials. A 12-page catalog C-1 is available for further information.
174 *Paul O. Abbe, Inc.

* From advertisement, this issue

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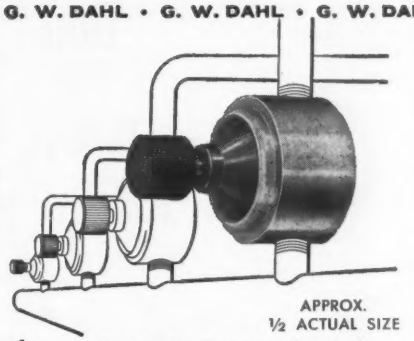
LOW COST MINIATURE VALVE FOR TIGHT SHUT-OFF!



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Dahl FLEXI-PHRAGM packless diaphragm valve ideal for instrument air and other gas and liquid services . . . for isolating and/or testing the pneumatic circuit in process control loops.

Resilient diaphragms (Neoprene, Viton A or Buna) withstand deformation by slurries, trapped impurities (unfiltered service) . . . still provide positive shut-off. Diaphragms resume original configuration when valve is opened and particles washed away . . . even after prolonged closures.

Rated to 500 psig and 180°F. Closing torque only 10 lb.-in. (as rated) in dead end service. Brass bodies with ⅛" or ¼" NPT connections. Panel mounts available.

REQUEST complete data on this low cost, high performance valve. G. W. Dahl Co., Inc., 84 Tupelo St., Bristol, R. I.

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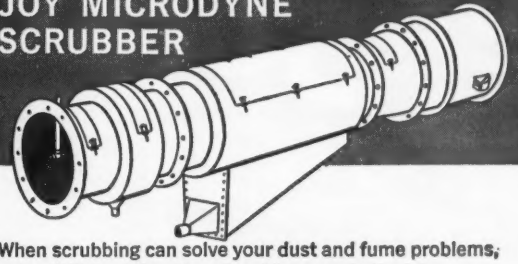
The COMPACT dust collector that fits into 1/10th the space!

JOY MICRODYNE SCRUBBER



When scrubbing can solve your dust and fume problems, only a WP Joy Microdyne Scrubber can do the job so efficiently in so little space.

Needs only a fraction of the space of other collectors . . . weighs far less . . . yet delivers highest efficiency. Installs in existing duct system, in horizontal or vertical position . . . often at the dust source. Steel or corrosion resistant alloy construction.

WRITE FOR LITERATURE today to Western Precipitation, 1000 W. 9th St., Los Angeles 54, Calif. (In Canada, write 8285 Mountain Sights Ave., Montreal, P. Q.)

DUST AND FUME CONTROL SINCE 1907

WESTERN PRECIPITATION

DIVISION OF JOY MANUFACTURING COMPANY

DIAL THIS PUMP FOR THICK OR THIN

Vari-Flo changes capacity instantly

If you're moving a variety of liquids—or one liquid at changing temperatures—there's no need to use several pumps. One Blackmer Vari-Flo can solve your problem, save you time and money. With Vari-Flo, you just dial a low capacity for thick liquids, then gradually increase the rate as the liquid gets thinner. Even reverse the flow without changing pump speed or direction! Vari-Flo does all this with an ordinary, standard-speed motor. See how it works to solve your pumping problems. Write for Bulletin 600.

"liquid materials handling"® equipment

BLACKMER / *vari-flo pumps*

BLACKMER PUMP COMPANY, GRAND RAPIDS 9, MICHIGAN

Find your Blackmer Man under "Pumps" in the Yellow Pages

...without help, using a POWER-CURVE Loader

Bag loading costs of eight cents a ton are not uncommon in plants using Power-Curve equipment. One man loads and stacks direct from the packer with no need to lift a single bag. Loads can be palletized or stacked in any pattern, also put into warehouse storage.

There are Power-Curve installations near you. Let us show you how your plant can benefit from a custom engineered Power-Curve loading operation.

Literature and engineering details sent on request.

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LITERATURE . . .

Blender.....Liquid-solids blender granulates tablet formulations in a single step. A new report on solid-blending and Catalog 16-P on process equipment is available.
56-57 *Patterson-Kelly

Centrifugal.....The new Model HS 40 W pressure centrifugal features completely and readily accessible interior. Complete specifications are available.
73 *Baker, Perkins, Inc.

Centrifugal Mixers.....Advantages of centrifugal action for mixing, dispersion and dry homogenization are reviewed in 4-page technical bulletin.
198A Entoleter, Inc.

Classifiers.....can be operated in series to obtain several closely sized fractions in one continuous operation. Further information is available.
213 *Buell Engineering Co.

Dispersall Mixer.....offers mixing, milling, blending and emulsifying in one operation. Further details are contained in Catalog 78 which is available.
R201 *Abbe Engineering Co.

Drum Filters.....Information is available on the Bicraft system for anyone interested in belt type drum filters. Fluid Tension roller continuously smooths the cloth.
135 *Peterson Filters & Engrg. Co.

Dryer.....SCF dryer is now in compactness, appearance, performance and economy. Has lower housing and complete accessibility of all parts. Bulletin 462.
153 *Proctor & Schwartz, Inc.

Dust Collector.....Amerjet for collection of the finest particles & particles that must be recovered dry. Bulletin 279 is available for further information.
14-15c *American Air Filter Co.

Dust Collector.....The W Roto-Clone requires little maintenance, uses a minimum of water & maintains efficiency regardless of variation in air volume. Bul. 272B.
14-15a *American Air Filter Co.

Dust Control Equipment.....works quickly and efficiently to reclaim valuable dust for you. Equipment for all your needs is available. All the facts on request.
75 *Pangborn Corp.

Dust Control System.....uses cloth filter bags to provide high-efficiency collection of all visible particles. Each system engineered to your layout.
193 *Dracco Div., Fuller Co.

Dust Filters.....The Dynaclone operates continuously & provides 20 to 40% more cloth. Automatically self-cleaning by reverse air. The 36-page Catalog 104 offered.
172 *The W. W. Sly Mfg. Co.

Ejectors.....Standard ejectors are available in sizes up to 3-in. maximum suction for fast delivery. They are simple, dependable and low-cost vacuum-producing devices.
B199 *Elliott Company

Horizontal Mixers.....Design, technical and dimensional data given in catalog for mixers for free flowing, granular materials with capacities from ½ to 500 cubic feet.
198B The Young Machinery Co., Inc.

* From advertisement, this issue

Liquids-Solids Separation.....Eight types of centrifugals and filters to separate solids from liquids. Research & Development Center for pilot-scale testing.
2 *Bird Machine Company

Mixers.....Turbo-Mixers for a wide range of mixing applications. Descriptive details on these mixers are contained in Bulletins T-11 and T-1159 which are offered.
32 *General American Transp. Corp.

Mixers.....Lightnin mixers cut downtime in three places at once. They offer shaft seal assemblies and come all assembled in one package, aligned & ready to install.
216 *Mixing Equipment Co.

Mixers.....Dependable mixing is assured to give you more profit in your process. Used for agitating, mixing, reacting, suspending solids & other applications. Bul. 581.
87 *Nettco Corp.

Mulling.....The 12-page handbook on mulling explains controlled dispersion & gives details on 9 Mix-Muller models (¾ to 60 cu. ft. batch capacity).
107 *National Engineering Co.

Portable Mixers.....12-pages of engineering data on portable mixers given in bulletin 194 which includes information on factors involved in the mixer selection.
199A The Cleveland Mixer Co.

Pressure Filters.....Sluice-O-Matic horizontal pressure filters are described in an application report, 100P-12-N-7 which is available on request.
145 *Industrial Filter & Pump Mfg. Co.

Process Equipment.....Catalog "A" discusses pressing, drying and cooling equipment and will give help in solving your particular problem.
B180 *Davenport Machine & Foundry Co.

Process Equipment.....12-page bulletin discusses design and performance characteristics of pumps, conveyors, compressors, coolers, heaters, blowers, exhausters, etc.
199B Fuller Co.

Pulverizer-Classifier.....Bulletin describes machine with high accuracy in controlled size reduction and classifying to any specifed finess.
199C **The Bauer Bros. Co.**

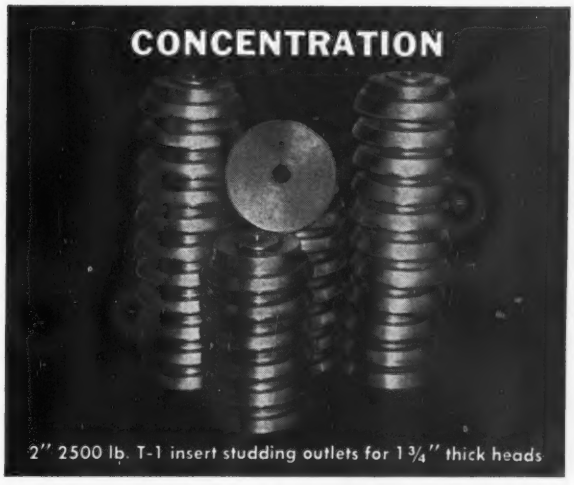
Scrubber.....4-page brochure describes polyethylene fume and dust scrubber designed to handle corrosive fumes and dusts with complete safety.
199D American Agile Corp.

Scrubber.....Joy Microdyne scrubber does the job so efficiently in so little space. Steel & corrosion resistant alloy construction. Literature is offered.
B197 *Western Precipitation

Solid-Liquid Proportioning.....Bulletin describes method combining manufacturers equipment for dry and liquid feeding, continuous weighing and flow metering.
199E B-I-F Industries

Tickeners.....A new 24-page brochure, Bulletin No. 3002, describes the complete line of thickeners for chemical, metallurgical and industrial processing.
199F Dorr-Oliver Inc.

*From advertisement, this issue



By concentrating on pressure vessel construction problems, Lenape can offer the widest range of studding connections for pressure vessels of all types. Their attractive low silhouette design provides easy access to the vessel. Simply attached, their reduced welding costs are a boon to pressure vessel fabricators and users everywhere.

Write for Catalog giving full details and specifications.

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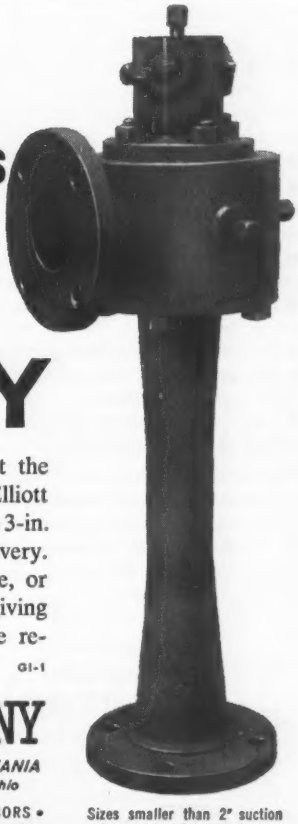

For producing a vacuum, you can't beat the simplicity, dependability and low cost of Elliott steam jet ejectors. STANDARD sizes, up to 3-in. suction openings, are available for fast delivery.

For prices, contact nearest Elliott office, or write Elliott Company, Jeannette, Pa., giving application, capacity and suction pressure required, steam temperature and pressure. 61-1

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Sizes smaller than 2" suction have screwed connections.

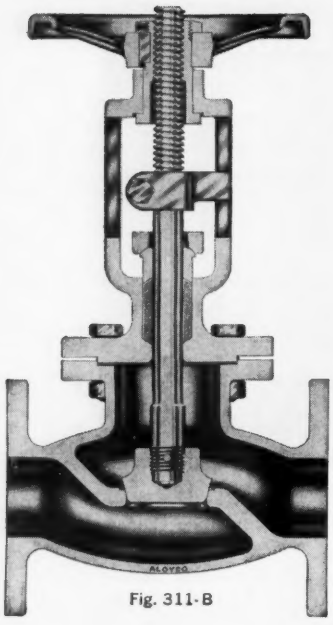

Fig. 311-B

7 ADVANTAGES OF THE NEW ALOYCO GLOBE VALVE DESIGN!

Redesign of sizes 2 inches and larger involves conversion from a rotating stem with rising handwheel and free floating disc to a non-rotating stem, non-rising handwheel with disc assembly pinned to the stem. Advantages include:

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- Rapid visual check of throttling control by observing location of stem stop.
- No galling of back seat because of rotating stem.
- No galling between seat and disc.
- Stronger disc to stem connection.
- No spinning of disc.
- Less corrosion attack because of elimination of cavity between stem and disc.

For more information on these Aloyco valves of Stainless Steel and other corrosion resistant alloys, write for Bulletin #7, Alloy Steel Products Company, Inc., 1301 West Elizabeth Avenue, Linden, New Jersey. 1.10

Subsidiary of

Longer Lasting ALOYCO VALVES

TRY 'EM IN CORROSIVE SERVICE

ALLOY STEEL PRODUCTS COMPANY

LITERATURE . . .

Vacuum Dryers.....designed to meet your specific needs. A new booklet, "Handy Guide to Vacuum Dryer Selection" has been prepared & is available on request.
26-27 *F. J. Stokes Corp.

Wet Collector.....Type N Roto-Clone combines action of centrifugal force & thorough intermixing of water & dust-laden air. Complete information in Bulletin 277.
14-15b *American Air Filter Co.

Pumps, Fans & Compressors

Air Compressor.....features air power, efficiency at all key points, perfect running balance and low, low maintenance. Full details are contained in Bulletin 185.
37 *Clark Bros. Co.

Air Pumps.....Two pumps for vacuum, pressure or gas boosting operations with vacuum to 26" hg., pressure to 13 psig. and volumes from 12 to 54 cfm described in bulletin.
200A Leiman Bros., Inc.

Blower Units.....4-page folder covers both low and high pressure blowers and includes schematics and specifications plus operating and maintenance instructions.
200B
Systems Engineering & Manufacturing Co.

Centrifugal Pumps.....20-page well illustrated booklet contains information on installation, maintenance and service plus operating data.
200C Worthington Corp.

Compressor.....“Compressor Evacuation Guids” points out the six key areas of judgment required for compressor evaluation and details them in full.
Cover *Worthing Corporation

Compressors.....built for the rugged duty typical of chemical plants. Heavy casings & conservative rod loadings enable them to easily handle air & gases. Bul. 2561-11.
52 *Joy Mfg. Co.

Fan.....Resin-Bonded Fiber Glass Fume Fans are resistant to such chemical corrosives as acids, salts, gases, organic materials & others Bulletin FI-511.
30e *Buffalo Forge Co.

Metering Pump.....Pulsafeeder metering group offers precision metering at flow rates of from a few drops to 15.7 gal. per minute. Complete details in Catalog 59.
178 *Lap Insulator Co.

Metering Pumps.....New metering pump design cuts maintenance time in half. Drive unit is completely enclosed. Further information is available on request.
195 *Wallace & Tiernan, Inc.

Plastic Pump.....defeats corrosion. Each chemical pump is thoroughly tested before delivery and carries a full warranty. A full line of plastic pipe, fittings & valves.
187 *Kraloy-Chemtrol Co.

Portable Pump.....Bulletin describes utility pump used in pumping slurry, proportioning chemicals, sump cleaning, recycling, or handling corrosive fluids.
200D Texsteam Corp.

* From advertisement, this issue

Size Requirements Getting Tougher?

Sturtevant Air Separators Increase 40 to 400 Mesh Output as Much as 300%

Closed-circuit air separation is a proved advantage in reduction processes. Result is a better, more uniform product. Grinding mills perform at top efficiency, output frequently increases as much as 300%, power costs drop as much as 50%.

Precise separation of all dry powdered materials. Sturtevants currently classify sulfur, soybeans, phosphate, chocolate, feldspar, sand and aggregates, pigments, limestone fillers, flour, abrasives, plastics, gypsum, ceramics, cement and other products.

Improve screening — Sturtevant Air Separators prevent blinding by removing undesirable tailings *or* fines from screen feed loads.

Works Like Winnowing Done in a Whirlwind

Sturtevant Air Separators do a mechanical job of winnowing. Precise control of whirlwind air currents and centrifugal force results in the desired size being lifted into fines cone, oversize falling into tailings cone.

A 16 ft. Sturtevant, for example, has taken a feed rate of 800 tph, containing only a *small* percentage of desired fines, and delivered 30 tph 90% 200 mesh, recirculating the oversize through the grinding circuit.

Send for Bulletin No. 087.

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(*"Income Quotient")

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"Intellectual let-down" — that tendency so common to many engineers to "stop learning" as soon as they acquire a sheepskin — will be completely out of style by 1999. Indeed, it is passe in today's accelerated engineering profession, because to stop learning is to stop growing: to stifle imagination, to throttle creativity, and ultimately to kill scientific progress.

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There is no magic formula for the "successful engineer," but for what they are worth to your professional future, here are 14 "ground rules" for your consideration:

Set objectives for your professional and personal life, re-examine them periodically, but always work towards a goal in life.

Develop sound work habits. Earn a reputation for promptness, attention to detail, accuracy, diligence, reliability.

Continue to study your chosen field or specialty. Your learning process must never cease functioning.

Seek additional training, technically or in non-technical fields which can be of importance to future development.

Think creatively about your job, your company, technological advances and developments. Dare to think **beyond** your capacity.

Expand your capacity to discover new fields of endeavor, discriminatingly, however, so that they will have application to your objectives.

Take a genuine interest in people, their potentials, their problems. Understand, but don't condemn, their shortcomings.

Broaden your base of appreciation for other pursuits, such as sales, accounting, law, advertising. They, too, are important to your company.

Study the fundamentals of business. Learn the economics of your company, its basic philosophy, its obligations and responsibilities, its opportunities and limitations.

Seek advice and counsel from others; don't rely entirely on your own resources . . . Ask questions.

Participate actively in technical societies; keep alert to professional trends, changing concepts, new developments.

Use common sense and sound, practical judgment in evaluating everything from people to processes.

Aggressively pursue your professional and personal ambitions, but with patience and intelligence.

Learn to communicate your ideas and opinions pleasantly, clearly, concisely, aggressively to your superiors, associates, subordinates.

The development of a successful career in engineering requires **constant, consistent dedication** to professional and personal principles. These few paragraphs may serve as a guide for your own advancement and future, but for a more detailed discussion on this topic, write for your free copy of Booklet E-2, "Personal, Professional Advancement," to WESTERN SUPPLY COMPANY, HEAT EXCHANGER DIVISION, P. O. BOX 1888, TULSA, OKLA. — and if there's a heat exchanger in your company's future, we'd like to demonstrate how these same "ground rules" affect our heat exchangers.

LITERATURE . . .

Pumps.....Bulletin describes pumps available in both adjustable and non-adjustable models for metering, injecting, sampling, feeding, mixing or lubricating.
201A Airmatic Valve, Inc.

Pumps.....Vari-Flo pumps change capacity instantly. You can dial this pump for thick or thin flow of liquids. Additional information in Bulletin 600.
T198 *Blackmer Pump Co.

Pumps.....4-page bulletin 1100-1 describes complete line of seal-less leakproof pumps and covers design, operation and selection of canned pumps.
201B Chempump Div., Fostoria Corp.

Pumps.....58-page booklet on high vacuum vapor pumps contains data on selection and performance characteristics plus schematics and performance curves.
201C Consolidated Vacuum Corp.

Pumps.....Rotary and sump pumps, end suction and vertical immersion process pumps are of special interest to the processing industries. Descriptive literature is offered.
97 *The Deming Co.

Pumps.....Model 3195 pumps simplify process engineering and cut parts inventories. They offer maximum interchangeability. Bulletin.
108 *Goulds Pumps, Inc.

Pumps.....PR and PRS pumps are available in 1" to 8" sizes inclusive. Designed to handle hot oil, hot water, hydrocarbons & many chemicals. Bulletin B-1605.
40-41 *Peerless Pumps

Pumps.....Moyno pumps are available in capacities to 500 gpm; pressures to 1000 psi. For corrosives, suspended solids & abrasives. Bulletin 100-XX.
49 *Robbins & Myers

Pumps.....End suction centrifugal pumps are offered in 350 series for chemical & 300 series for general process services. A 12-pag catalog is available.
165 *C. H. Wheeler & Co.

Pumps, Acid.....with rugged, simple frame construction & packingless design. Long wear parts, few in number, are available in a variety of metal alloys as well as plastic.
215 *A. R. Wiffley & Sons, Inc.

Pumps, Diaphragm.....Both Model DDV-2 and Model DA-4 are available in standard carbon steel or with 316 stainless wetted parts. Further details are available in catalog.
162 *Layton Co., Inc.

Services & Miscellaneous

Chemical Plant.....Chemical companies interested in expanding their manufacturing facilities are invited to write for the current 12-page Kelloggram.
183 *The M. W. Kellogg Company

Closed Circuit TV System.....Kin-Tel equipment is reliable and features picture quality, automatic operation, ease of installation, etc. Catalog 6-103 has details.
85 *Kin-Tel Div., Cohu Electronics

* From advertisement, this issue

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DISPERSALL MIXER

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The Abbé Dispersall Mixer disperses, mills and blends (as well as emulsifies) in ONE operation. Solid ingredients are *completely* dispersed in a fraction of the time required by conventional mixers. Eliminates pre-milling and pre-mixing.

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LITERATURE . . .

Corrosive Fumes.....36-page catalog describes how to handle corrosive fumes with fans, air washers, and exhaust systems made of polyvinylchloride.
202A Industrial Plastics Fabricators, Inc.

Cryogenic Data Card.....Card includes data on 11 physical properties of 32 cryogenic fluids in both engineering and metric units, plus table of conversion factors.
202B Cryogenic Engineering Co.

Electrodialysis.....Booklet describes process for converting brackish water to fresh, pure water and includes information on design features and flow diagrams.
202C Aqua-Chem, Inc.

Fire Fighting Products.....To step up your department's life-saving power, equip with FOAM systems, nozzles and FOAM liquid. Complete details are available.
95 *Rockwood Sprinkler Co.

Gas Cylinders.....Catalog contains specifications, sizes and recommended applications for all of manufacturers cylinders available for compressed gas uses.
202D Pressed Steel Tank Co.

Gas Producer.....Bulletin explains How Hydralene gas producers provide a steady source of high purity hydrogen with material costs 10% that of cylinder gas.
202E General Electric Co.

High Vacuum Equipment.....23-page catalog describes high vacuum systems, instruments and valves and provides detailed descriptions and technical specifications.
202F F. J. Cooke Inc.

Lubrication Equipment.....32-page catalog features line of lubricant application equipment with descriptions of manual and fully semi-automatic methods of operation.
202G Lincoln Engineering Co.

Neutrons.....4-page folder gives design data on tubes which provide neutrons in quantities intermmediate to those available from isotopic sources and reactors.
202H Philips Electronic Instruments

Pouring Spout.....Brochure shows the new Flo-Top pouring spout for 28mm plastic and glass containers. Provides instant, fast flow with no drip.
202 I Multi-Meter Corp.

Professional Advancement.....demands thorough engineering knowledge, disciplined habits, creative thinking & constant application. A detailed discussion in Bklt. E-2.
L201 *Webster Supply Co.

Shutdown Chart.....“Shutdown Master Planner” wall chart helps scheduling of equipment shutdown maintenance activities by indicating at a glance all items involved.
202J Westinghouse Electric Corp.

Telemetering System.....The Dynacode system is a new high-speed remote monitoring system based on Varec pulse code performance. Details in Bulletin 301.
69 *Dynel, Inc.

Water Service.....Provides speed, trained technicians and quality parts to remedy your water problem. Complete information on this service is contained in Bul. 100.
90 *Layne & Bowler, Inc.

* From advertisement, this issue

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ARTHUR P. WILSON ASSOCIATES
126 Prospect Place South Orange, N. J.

THE KNOLLS ATOMIC POWER LABORATORY

...Where Achievements in Research Are Applied Today... And Developed Into Tomorrow's Nuclear Systems...

Selective program expansion—and commencement of applied research and development projects in new and promising areas of nuclear reactor and power plant technology—have generated several new openings of unusual potential at KAPL.

Positions are immediately available in:

Theoretical Physics (PhD)
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Forward your resume in confidence to Mr. G. L. Smallwood, Dept. 65-WF

Knolls Atomic Power Laboratory
OPERATED FOR A.E.C. BY
GENERAL ELECTRIC
SCHENECTADY, N. Y.

U. S. Citizenship Required. All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

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Refinery and Chemical Division offers immediate employment opportunities for mechanical, chemical or instrumentation engineers capable of assuming responsibility on design of major petrochemical, refinery or similar processing units.

Relocation allowances cover moving costs plus transportation reimbursement for you and members of your family. If you have an interest in a San Francisco assignment, please send a resume of experience, including your present and required salary to George I. Copeland, Manager of Personnel.

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Corporation
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Desired for opportunities in large modern refineries of affiliates of STANDARD OIL COMPANY (N.J.). Candidates must be graduate Chemical Engineers with 3 to 5 years refinery experience and a working knowledge of refinery processes for performance analysis, design and economic evaluation of the operation of a major refinery. Possibilities for later assignment to Economics and Programming Group. Liberal employee benefits including home vacations with travel allowances. Interviews will be arranged for qualified candidates. All replies confidential. Send complete resume of work experience and personal data to:

P. O. Box 518
Department E
Radio City Station
New York 19, New York

ANALYTICAL CHEMIST

Quebec Iron and Titanium Corporation, world's largest producer of Titania Slag for the pigment industry and SORELMETAL for steel mills and foundries, requires the services of an experienced analytical chemist for its SOREL WORKS.

Qualifications include graduation in chemistry (B.Sc.) from a University of recognized standing; post-graduate studies in statistical analysis techniques is a must, and at least 6 years of progressively responsible analytical work, preferably in the metallurgical field. Bilingualism an asset.

Salary fully commensurates with qualifications and experience; excellent fringe benefits.

Apply in writing to:

Mr. Gerard Perron,
Quebec Iron and Titanium Corporation,
P.O. Box 40,
Sorel, P. Q., Canada.

"Put Yourself in the Other Fellow's Place"

TO EMPLOYERS

TO EMPLOYEES

Letters written offering Employment or applying for same are written with the hope of satisfying a current need. An answer, regardless of whether it is favorable or not, is usually expected.

MR. EMPLOYER, won't you remove the mystery about the status of an employee's application by acknowledging all applicants and not just the promising candidates.

MR. EMPLOYEE you, too, can help by acknowledging applications and job offers. This would encourage more companies to answer position wanted ads in this section.

We make this suggestion in a spirit of helpful cooperation between employers and employees.

This section will be the more useful to all as a result of this consideration.

Classified Advertising Division

McGRAW-HILL PUBLISHING CO., INC.

330 West 42nd St., New York 36, N. Y.

Equipment Searchlight

CE's Searchlight spots the big bargains in used, resale and rented equipment. Check this issue's listings—most complete in the field—for items you need now.

▶ **Coverage** — National. Equipment and facilities—used, resale and rental—for the process industries. For sale, wanted, for rent.

▶ **Rates**—$21.75 per inch for all ads except on a contract basis; contract rates on request. An advertising inch is measured ⅞ in. vertically on a column; 3 columns, 30 in. per page. Ads acceptable only in display style.

▶ **Closing date** — Sept. 4 issue closes Aug. 11. Send all new ads to Chemical Engineering, Classified Adv. Division, P. O. Box 12, New York 36, N. Y.

BEST VALUES

Evaporator: Buflovak dbl. eff. st.st. 845 sq. ft.
Evaporator: Buflovak dbl. eff. st.st. 608 sq. ft
Evaporator: Mojonnier dbl. eff. st.st. 1250 sq. ft.
Evaporator: Buflovak sgl. eff. st.st. 67 sq. ft.
Evaporator: Swenson four eff. C. I. 5700 sq. ft.
Dryers: Double Drum, 42 x 90; 32 x 100 Buflovak.
Dryer: Double Drum, 42 x 120 American.
Dryer: Rotary Steamtube, Louisville 6' x 25' (2).
Twin Shell Blender, Patterson-Kelly, 30 cu. ft. S.S. T304. 7½ H.P. drive.
Centrifuges Tolhurst 40" and 26" Suspended perf.
Centrifuges: Bird continuous, 18 x 28, S.S. T316.
Filter, Rotary Vacuum with pressure housing, Dorr Oliver 5'3" dia. x 4' face (2).
Tanks: 2300 (2)—1500 gal. Vertical St.St.
Tanks: 3000 (2)—1500—900 gal. vertical St.St. for vacuum, with coils.
Kettles: (2) 600 gal. agitated st.st.; with 15 P.S.I. steel jacket.

BEST EQUIPMENT COMPANY
1737 W. HOWARD ST. CHICAGO 26, ILL.
AMbassador 2-1452.

CIRCLE F ON READER SERVICE CARD

SPECIALS

Kettles: 60 gal. st. steel agit. ASME.
Mill: Day Hispeed Model B 14x30" 3-Roll.
Column: 24" x 22', 316 stain. steel.
Pebble Mills: Abbe #3, #6, and others.
Dryer: American 24x48" dbl. drum.
Dryer: Bowen lab. spray, st. st.
Evaporator: Buflovak sgl. eff. st. st. 94 sq. ft.
Dryer: Porter 2 x 4' vac. drum., st. st.
Centrifugal: Tolhurst 26" rubber, 2-speed.
Filter: Sweetland #5 st. st. lined.
Filter: Eimco, drum 18" x 12".
Vacuum Pans: 42" and 72" stain. steel.
Dryer: Proctor & Schwartz 6-tray st. st.
Centrifugal: AT & M 60" st. st. perf.

Write us or call Seeley 8-1431
Send us a list of your idle machines

LOEB EQUIPMENT SUPPLY CO.
820 W. Superior St., Chicago 22, Ill.

CIRCLE G ON READER SERVICE CARD

BOILERS
TURBO-GENERATORS • DIESELS
PUMPS • FANS • BURNERS • HEATERS

Large Selection . . . New and Used
EXPERIENCED ENGINEERS TO ASSIST YOU

WABASH POWER •EXPORT•

WABASH
POWER EQUIPMENT CO.
PHONE IN 3-0303
3300 W. PATTERSON AVE.
CHICAGO 45, ILL.

CIRCLE H ON READER SERVICE CARD

AUGUST SPECIALS

Day #40 Imperial Jkt. 300 gal. Mixer, 40 HP
Simpson 24" Lab. SS Mix Muller, 1½ HP motor
Day 75 gal. sigma arm Mixer with 7½ HP motor
2 Fitz Mills Model D, 5 HP motors
Abbe 5'x6' Jktd. Ball Mill, chrome mang. steel
Stokes vac. 2 shelf dryer 40" x 42" with pump
Gruendler #3 Hammermill, Whirlbeater, 22"
Pfaudler 1500 gal. glass lined Tank, closed top
Ribbon Blenders, Steel & SS, all sizes, New & Used

WHAT HAVE YOU FOR SALE OR TRADE?
YOU CAN BANK ON

EQUIPMENT CLEARING HOUSE, INC.
111 33 Street, Brooklyn 32, N. Y.
SOuth 8-4451—4452—8782

CIRCLE J ON READER SERVICE CARD

---

(2) 700 HP York Brine Chilling Units
(2) 100 HP Carrier Chilling Units
(1) 10 x 10 Frick Ammonia Compressor, 125 HP
(2) 9x9 York, 75 HP

JOHN F. CARSON
A & VENANGO STS. PHILA. 34, PA.
GArfield 6-2221

CIRCLE K ON READER SERVICE CARD

FOR SALE

$.0015X^3 + .030X^2 + 18X + 1 = 0$ reduced to $(.0224X^2 + .113X + 1)(.067X + 1) = 0$ in 20 seconds with the Cubic Solver slide chart. Reduce cubics easy and quick to $(AX^2 + BX + 1)(CX + 1) = 0$. Send $2.98—F. W. Jackson, 318 Maple Ave., Drexel Hill, Pa.

ECONOMIZE DOLLARWISE

2—Shriver 36" x 36" CI Filter Presses. 19—2" frms, 18 plts. Closed delivery.

1—Day SS 200 gal work cap Mogul Mixer. Heavy dbl nobben blades. Jcktd & Vac.

1—New Kelly SS long tube Evaporator. 751-1" OD 12 ga tubes 15' long.

2—New Struthers Wells 180 gal SS agit. jcktd Kettles. 100 PSI, code constructed. 7½ HP.

2—Sharples C-20 Super-D-Hydrators. Stainless contact. 20 HP motor.

2—16' Mechanical Air Separators. 1—Raymond Dbl Whizzer. 1—Sturtevant Whirlwind.

1—Merrick Model PIU cont Scale. Type S 180 Weight-O Meter. 3 TPH.

2—Tolhurst 48" perf. bas. Centrifuges. 304 SS. Mtrs brake & plow.

ME MACHINERY AND EQUIPMENT CO., INC.
123 TOWNSEND ST. · SAN FRANCISCO 7, CALIFORNIA

CIRCLE A ON READER SERVICE CARD

LOCOMOTIVES—RR CARS & CRANES

9 Gen. Elec. 20, 25, 45, 65, 70, 80, 100, 125 Ton
25-Ton Industrial Brownhoist 60' Boom Crane
200—50 Ton Box 300—70 Ton Gondola Cars
300—1½, 5, 20 & 30 yd Dump Cars

PLANT EQUIPMENT

2—Wemco 2M-HMS Plants
No. 1 Sturtevant Hammer Bar Mill
No. 2 Robins Vertical Cone Crusher
24" x 24" Jeffrey Single Roll Crusher
No. 1 Sturtevant Rotary Fine Reduction Crusher
F55 Syntron Grizzley Feeder
5' x 8' & 4½' x 9' KVS Air Swept Ball Type Mills
Ball Mills: No. 56, 5' x 5', 6' x 4', 6' x 8' & 7' x 22'
Hardinge Mills: 3' x 8', 5' x 22" & 8' x 22"
Rod Mills: 4' x 11', 6' x 12' & 7' x 15'
Jaw Crushers: 8" x 10", 9" x 24", 10" x 30", 12" x 26", 13" x 24", 14" x 28", 18" x 36", 30" x 36", 66" x 84"
Crushers, Fine Reduction: 22", 2', 3', 4', 5½' & 7'
636 & 436 Allis Chalmers Hydrocone Crushers
Crushers Roll: 24" x 14", 30" x 14", 40" x 16"
Rotary Dryers: 5' x 30', 6' x 50', 6' x 70' & 8' x 80'
Rotary Kilns: 6' x 70', 7' x 120' & 9' x 160'
2—42" x 120" Buflovak Atmos Double Drum Dryer
Roto Louvre #207-10 Type 316 S.S. Link Belt
150—1½, 2 & 4 yd & 30 yd Dump Cars
7'x120' Allis Chalmers Rotary Kiln ⅜" welded shell
3' x 12' Seco Single Deck Vibrating Screen
16' Gayco Centrifugal Air Separators
BX-100 Sutton Steele & Steele Air Table NEW
6—30" x 32" Dings Magnetic Head Pulleys
690', 2200', 3068' & 3600-7500' IR. Compressors
4100 CFM Sly Dust Collector

WANT BUY DRYERS—KILNS—CRUSHERS
R. C. Stanhope, Inc., 60 E. 42 St., N.Y. 17, N.Y.
Tel. MU 2-3075 or MU 2-1898

CIRCLE D ON READER SERVICE CARD

HOW to LOCATE EQUIPMENT
without cost or obligation

This service is aimed at helping you to locate Surplus New or Used equipment, if you do not find your present requirements advertised in this section.

Send us the specifications of the equipment wanted and you will receive an immediate reply with full details.

EQUIPMENT FINDERS BUREAU
SS-6663, Chemical Engineering
Class. Adv. Div., P. O. Box 12, N. Y. 36, N. Y.

CIRCLE B ON READER SERVICE CARD

BOILERS
HI-PRESSURE
turbogenerators, pumps, fans,
Nation's largest inventory, New & Used

INDECK POWER EQUIPMENT CO.
9750 Skokie Blvd., Chicago (Skokie) Ill. OR 3-7666

CIRCLE E ON READER SERVICE CARD

RAYMOND FLASH DRYING SYSTEM
Complete—Unused
LINK BELT ROTO LOUVRE DRYERS, 6'x24'
316 S/S
SPRAY DRYERS S/S. PRODUCTION & LAB.
SEND US YOUR INQUIRIES
N. J. SNOW EQUIPMENT CO.

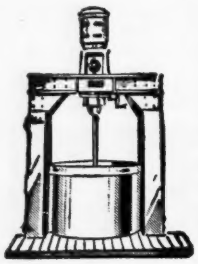
1700 Holcombe	Houston 25, Texas	JA 2-0359
507 Fifth Ave.	New York City	OX 7-5895

CIRCLE C ON READER SERVICE CARD

Make a Hit with your boss— BUY EQUIPMENT at ½ PRICE!

SAVE $7,000 on FIRST'S FEATURED SPECIAL

Western States Stainless Steel Centrifugal; 40"x24"; 25 HP Motor; with Unloader



FIRST COME — FIRST SERVED

SPECIAL OFFERING DIRECT FROM LOCATION CONTINUOUS FINE GRINDING EQUIPMENT
Being Removed as Operations Terminate

2—Allis Chalmers 7'x22' (2 Compartment) Compeb Ball Mills with Meehanite Liners, driven by a magnetic-coupled 400 HP Motor.
1—Allis Chalmers 9½x810 Preliminator or Continuous Ball Mill; Meehanite Liners, driven by a magnetic-coupled 400 HP Motor.
3—Allis Chalmers 7'x22' Continuous Ball Tube Mills, with Meehanite Liners, each driven by a magnetic-coupled 400 HP Motor, now operating in closed circuit with
3—Raymond 14 ft. Double Whizzer Mechanical Air Separators, New in 1950, each driven by 75 HP Motor. May be purchased separately. Send for Prices and Details.

DRYERS—EVAPORATORS

Devine Dbl. Door No. 36 Shelf Dryer; (20) Shelves, 86"x78".
Louisville MONEL Rotary Steam Tube Dryer; 54"x35'.
2 S/S Acme Continuous Rot. Vacuum Dryers or Concentrators.
Double Drum Dryers of Standard Make; 28"x60" to 42"x120".
2 F. J. Stokes Vacuum Impregnating Systems; complete.
Bowen Stainless Steel Table Model Spray Dryer; 30"x32".
Bartlett-Snow Jktd. Agtd. Batch Dryer; 6' Dia.; 49 cu. ft.
Zaremba Double Effect INCONEL Evaporator with Calandria.
Buflovak S/S Sanitary Thermo-Recompression Evaporator Complete.

MIXERS FOR EVERY PURPOSE

Brand NEW FALCON Ribbon Blenders; all sizes now in Stock; S.S. or Mild Steel.
Baker Perkins Heavy Duty Jacketed Mixers; from 5 gal. to 300 gal.
J. H. Day Mogul Mixer, 150 gal. Vac. Cover; 75 HP.
Dry Cincinnatus Double ARM Jacketed Mixers, 75, 200, 300 gal.

CENTRIFUGES—CLARIFIERS

Stainless Suspended Type Centrifugals from 30" to 60".
2 Sharples Stainless Steel Model PN14 Super-D-Canters.
Sharples C-27 Super-D-Hydrator in Type 316 Stainless; 40 HP.
2 Bird Continuous Horizontal Centrifuges; S/S & Monel 24".
2 Bird Rubber Covered Fume-Tight 48"; with Plows; 40 HP.

FILTERS AND FILTER PRESSES

Oliver Pre-Coat; 3"x2" Monel; 5'3"x8' Stainless; 5'3"x3' Steel.
Feinc Stainless Steel Rotary Vacuum Filter 3'x1'.
4 Pressure Filters in 316 Stainless; 100 sq. ft.; 30"x56".
Bowser Filter 200 G.H.P. complete with Pump and Motor.
Shriver and Sperry Plate & Frame Filter Presses; all sizes.

REACTORS & PRESSURE VESSELS

Struthers Wells 2000 Gal. Stainless Reactors; Jktd. and Agtd.
2 Stainless 400 Gal. Reactors Jktd. & Agtd. by Struthers Wells.
6 Dorr-Oliver 550 gal. Stainless Thickeners or Reactors.

MILLS—GRINDERS—PULVERIZERS

Mikro Pulverizers up to No. 4; Mikro S/S Atomers No. 5 and No. 6.
Fitzpatrick Comminutating Machines, in Stainless; Models M, D and K.
Abbe Jacketed Steel Ball Mill; 42" x 32"; with charge of balls.
International Porcelain Lined Pebble Mills; 8' x 8'; 50 HP gearmotors.

SPOTLIGHT SPECIAL: Buflovak Rotary Vacuum Dryer 3'x7'6" in Type 316 Stainless, Jktd., Agitated with Cyclone, Dust Collector, Condenser etc.

FIRST MACHINERY CORP.

209-289 TENTH STREET, BROOKLYN 15, N. Y.

FMC Pays MORE For Your Surplus

PARKING ON THE PREMISES
Phone: STerling 8-4672
Cable Address: "EFFEMCY"

CIRCLE L ON READER SERVICE CARD

NEW FILTER, stainless steel NIAGARA 48" dia. w/510 sq. ft.

NEW GRANULATOR #24, Stokes oscillating, S/S, also used 43A, S/S

NEW VOTATOR, S/S, lab. model, 4 speed

FURNACE, electric, 5"X12"X30" muffle, 1600°C, Globar, w/50KVA transformer

MIKRO PULVERIZERS, 2 model 2TH w/ 10HP motors & vari-drive feeds

OVEN, Truck/Tray, 650° F. electric, 5'X6'6"X14', self-contained package unit.

LAWLER COMPANY
Durham Ave. Liberty 9-0245 Metuchen, N. J.

CIRCLE M ON READER SERVICE CARD

COMPRESSORS

No better values at any price

72 CFM 1500 PSI 6¼-3¾-1⅜x7 CP
138 CFM 100 PSI 7x7, Ing. ES, CP & Joy
258 CFM 500 PSI 9½x4¼x11 Ing. ES2 New
288 CFM 100 PSI 9x9 Ing. Worth, CP
311 CFM 1500 PSI 10½x7⅛-3½-13 IR-ES3
420 CFM 40 PSI 12x9 Gardner (Ethylene)
465 CFM 100 PSI 12x11-1R-ES CP.T. Worth HB
502 CFM 125 PSI 12x13 Worth HB
676 CFM 110 PSI 15-9¼x12 Ing. XRE
686 CFM 100 PSI 14x13 Ing. ES
805 CFM 125 CFM 17-10x12 CP oce
1050 CFM 60 PSI 13-13x12 1R-XRE
1852 CFM 110 PSI 23-14x14 Ing. XRE
300 HP GE Syn 3-60-440 (2) 1952
2200 CFM 100 PSI 26-15x26 Ch. Pn. oce 350-HP 3-6-4160-4600 .8 PF
2610 CFM 45 PSI 20-20x14 Ing XRE 250 HP Syn.

AMERICAN AIR COMPRESSOR CORP.
Chem. Road, North Bergen, N.J. UNion 5-1397

CIRCLE N ON READER SERVICE CARD

AMAZING VALUES

STAINLESS MICRO PULVERIZER

3—New Model 1-SH Micro Pulverizers. Stainless Steel construction. 5 HP main motor and gearhead auger motor.

Immediate Delivery From Stock

ME MACHINERY AND EQUIPMENT CO., INC.
123 Townsend St. · San Francisco 7, Calif.

CIRCLE O ON READER SERVICE CARD

OUTSTANDING VALUES!

400 gal SS jktd and agit reactor.
40" rubber lined centrifuge.
Readco 50 gal H.D. dbl arm mixer.
Hersey 1½' x 16' rot dryer.

CHEMICAL & PROCESS MACHINERY CORP.
50-52 9th St., Brooklyn 15, N. Y. HY-9-7200

CIRCLE P ON READER SERVICE CARD

FOR SALE

1—50 gal. S.S. Reaction Kettle
3—Colton Single Piston Tube Fillers
Bird type Continuous S.S. Centrifuges, 21", 30" x 40" tapered
Laboratory Model 7".

CONSOLIDATED PRODUCTS CO.
150 Observer Highway Hoboken, N. J.
Tel: BA 7-0600.

CIRCLE Q ON READER SERVICE CARD

LIQUIDATIONS

CLEVELAND, OHIO

1—Raymond #73612 Super High Side 6-Roll Mill, with whizzer, cyclone, piping and motors.
1—Raymond # 6669 Super High Side 6-Roll Mill, with whizzer, cyclone, piping and motors.
1—Raymond #5047 High Side 4-Roll Mill, with whizzer, cyclone and piping
1—#1 Raymond Impact Mill, with whizzer, cyclone and piping.
1—Raymond 12′ dia. Double Whizzer Air Separator.
2—Sturtevant 14′ dia. Air Separators.

1—Kilby Nickel Single Effect Force Feed Evaporators, 1200 sq. ft.
2—12,000 gal. Nickel Clad Tanks.
2—Oliver 5′3″x4′ Nickel Clad Rotary Vacuum Filters.
2—Pfaudler 300 and 200 gal. Glass Lined Jkt. Agt. Reactors.
1—Sperry 30″ C.I. Filter Press, 27 chambers.
1—Buflovak 32″x90″ Dble Drum Dryer.
4—Feinc 8′x12′ Rotary Vacuum Steel Filters, string discharge.
2—Peabody Gas Scrubbers stainless steel 11,000 CFM and 6,000 CFM at 145°F with fans, motors.
2—6′6″ dia. x 60′ Rotary Dryers.
1—5½′x4½′x50′ Rotary Dryer.
1—5½′x4½′x60′ Rotary Dryer.
7—Dorr 80′ and 40′ thickeners.
3—Vogt 387 sq. ft. Rotary Press. Filters.
2—Chicago Pneumatic 26″x14″ Vacuum Pumps with 150 HP motors.
3—Fuller Kinyon Pumps H5 and H6.
1—Link-Belt 24″x90′ Belt Conveyor
5—Nickel Centrif. Pumps, 2″, 3″.

GENEVA, NEW YORK

2—Vulcan 3′x20′ 347 S.S. Packed Columns with 240 sq. ft. S.S. Heat Exchanger.
5—S.S. Condensers 70 to 250 sq. ft.
6—Nash H5, L5 Vac. Pumps 20 & 15 HP.
1—Nash L3 Stainless Vacuum Pump.
6—1,200, 1,000 & 400 gal. 347 S.S. tanks
8—25,000 gal. Aluminum Storage Tanks, ½″ shell.
2—3000 gal. Aluminum Tanks, 7′x11′.
1—Tolhurst 40″ Centrifuge 347 S.S. imperforate basket, 15 HP.
1—Swenson Vert. 347 S.S. Single Effect Evap. 300 sq. ft.
2—Banks S.S. cooling coils, each bank having 24—2″ tubes 20′ long.

BRILL FOR VALUES

CENTRIFUGES

3—Bird 18″ x 28″, 24″ x 38″ Solid Bowl Continuous 304 S.S.
1—Bird 40″ x 60″ Solid Bowl Continuous 316 S.S. UNUSED.
5—Sharples C-20 and C-27 Super-D-Hydrator 316 S.S.
3—Sharples PY 14, PN14 Super-D-Canters 316 S.S.
2—Sharples #16, 304 S.S., 3 HP motor.
1—Tolhurst 40″ 347 S.S. imperforate basket 15 HP UNUSED.

TANKS

25—500 to 3500 gal. Vertical 304 S.S. Tanks opened and closed, some agitated.
6—7500, 6000 and 2000 gal. Rubber Lined Tanks.
1—1500 gal. Stainless Pressure Tank, 5′ x 10′, 90#.
1—2000 gal. Horizontal 304 S.S. Tank 5′ x 12′.
1—2500 gal. Vertical 304 S.S. Tank 8′ x 7′.
1—10,000 gal. Rubber Lined Tank 10′ x 17′6″.
1—5500 gal. 316 S.S. Clad Pressure Tank 250 PSI.
1—12,000 gal. Horizontal Steel Pressure Tank 7′6″ x 36′, 200 PSI.
5—25,000 gal. Aluminum Storage Tanks.

REACTORS—EVAPS—CONDS—COLUMNS

1—Pfaudler 125 gal. 304 S.S. Jacketed Agitated Reactor 150# int., 125# jacket.
3—Pfaudler 200 gal. glass lined jacketed Kettles.
2—Pfaudler 850 and 650 gal. Steel Jacketed, Agitated Reactors.
1—650 gal. 304 S.S. Reactor with 100 sq. ft. Bayonet Heater.
1—O. G. Kelly 3000 sq. ft. 309 S.S. force feed Evaporator UNUSED.
1—550 sq. ft. Buflovak monel single effect Evaporator.
10—Stainless Heat Exchangers; 910, 536, 370, 250, 131, 70 sq. ft.
1—4′6″ x 46′ 316 S.S. Clad Column, 250 PSI.
6—30″ x 19′ S.S. Packed Columns.
1—24″ x 35′ 304 S.S. Bubble Cap Column.

FILTERS

2—Niagara 110 sq. ft. Vert. 316 S.S.
1—Niagara 92 sq. ft. Vert. Jkt. 316 S.S.
2—#10 Sweetland, 27 leaves 4″ centers
1—#5 Sweetland 304 S.S., 120 sq. ft.
1—Oliver 6′ dia. Horizontal 316 S.S.
1—Oliver 4′ dia. Monel Horizontal.
1—U.S. 200 sq. ft. 304 S.S. Auto-Jet.
1—Hercules 400 sq. ft. 304 S.S. Pressure.
3—Oliver Precoat 5′ x 6′, 5′ x 10′, 8′ x 10′.
1—Oliver 5′3″ x 8′ Steel Rotary Vac housing.
1—Feinc 3′ x 1′ 316 S.S. Rotary Vac.

DRYERS

1—Buflovak Vacuum Shelf, 17—60″ x 80″ shelves.
2—Buflovak 42″ x 120″, atmospheric double drum complete.
1—Buflovak 32″ x 90″ Atmos. Twin Drum.
2—Devine 4′ x 9′ single drum, atmospheric.
1—Buflovak 3′ x 10′ Rotary Vacuum.
1—Stokes 4′ x 20′, 304 S.S. Rotary Vacuum.
6—Louisville Rotary Steam Tube 5′ x 6′, 6′ x 30′, 6′ x 50′.
2—Louisville 8′ x 50′ Stainless Steel lined Rotary.
3—Rotary Dryers 4′ x 40′, 6′ x 50′, 6′ x 60′, 7′ x 80′, 8′ x 87′.
1—Louisville 4½′ x 25′ Inconel Rotary.
2—Link Belt 7′5″ x 25′, 6′4″ x 24′, S.S. Louvre Dryers.
1—Stokes model 38-A Tray Dryer with 16—36″ x 36″ S.S. Shelves.
2—Atmos. Tray, 16 shelves, 40″x24″.
2—10′ and 4′ dia. 304 S.S. Spray Dryers.
2—Wyssmont, 304 S.S. 6′2″ and 9′6″ dia.

MIXERS

1—Sturtevant 75 cu. ft. 304 S.S. Rotary Batch Blender 20 HP.
1—Abbe 110 gal. 304 S.S. Jacketed Agitated Vacuum Dispersall Mixer.
2—Day Imperial 150 gal. jktd. double arm.
2—Baker Perkins 150 and 100 gal. jacketed double arm Sigma blades.
1—Baker Perkins 50 gal. jacketed.
5—Day "Cincinnatus" double arm, 250 and 100 gal.
2—Steel jacketed Powder Mixers, 225 and 350 cu. ft.
1—1500# Powder Mixer 304 S.S.
1—3′ dia. Simpson Intensive Mixer.
1—45″ dia. Lancaster Mixer 7½ HP motor.
1—Patterson 80 cu. ft. Conical Blender, 304 S.S.

MISCELLANEOUS

3—Kinney Vacuum Pumps, 1000 cfm, 10 microns, 15 HP.
2—Hardinge 5′ x 22″ steel lined conical Ball Mills.
3—Mikro Pulverizers, 1SH, 1SI and Bantam.
3—Abbe 2½″ x 3′ porcelain lined Pebble Mill XP motor.
1—Raymond 10″ vert. Mill, 10 HP.
3—Swenson Walker Continuous Crystallizers, 24″ x 30′ sections.
2—#24 Rotex Sifters 20″ x 64″, 40″ x 56″.
5—Day Roball Sifters, 40″ x 120″, 40″ x 84″, Double Deck.
6—Nash H6, H5, H3 Vacuum Pumps.
3—Nash H6, 347 S.S. Vacuum Pumps.
4—Stokes Rotary Tablet Machines DD2—DDS2—DS3—RB2.

Partial List of Values—Send for Complete Circular

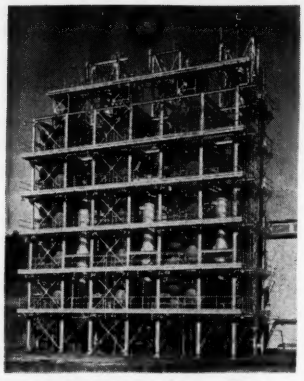
BRILL EQUIPMENT COMPANY

35-61 JABEZ ST., NEWARK 5, N. J. Tel: MArket 3-7420—N. Y. Tel: RE 2-0820
TEXAS OFFICE: 4101 San Jacinto St., Houston 4, Texas—Tel: JAckson 6-1351

CIRCLE R ON READER SERVICE CARD

MULTI-MILLION DOLLAR LIQUIDATION

NORTH LITTLE ROCK, ARK.



STAINLESS STEEL TANKS

6—13,300 gal., 11'10"x15'7", cone top.
3—12,000 gal., 11'6" x 15'6", cone top.
18—3650 gal., 10' x 7', open top.
3—3000 gal., 5' x 19', T347SS, ASME 60 psi, dished heads.
60—1350 gal., 4' x 14', T347SS, ASME 60 psi, dished heads, int. coils.
9—1300 gal., 7' x 4'6", T321SS, closed
3—1100 gal., 4' x 11', T347SS, ASME 60 psi, 3/16" shell, ¼" heads.
27—476 gal., 4'6"x4', open top.
54—475 gal., 5'6"x2'6", open top.
27—445 gal., 6'x2', open top.
3—300 gal., 4'x3', T347SS, ASME 60 psi, dished heads.
9—285 gal., 41"x49", open top.
9—260 gal., 40"x48", closed top.

GLASS-LINED TANKS

18—Pfaudler 11,500 gal. horiz. blue glass-lined tanks, 8' x 30', ½" shell, 7/16" dished heads, 20 psi. With 75 sq. ft. nickel coil, Aurora St. St. sump pump.

STEEL PRESSURE TANKS

9—28,000 gal. 11' x 38', dished, ASME 75 psi.
11—28,000 gal. 11' x 38', lead-lined.
2—14,000 gal., 8' x 36', dished.
2—11,000 gal., 8' x 27', dished, ASME 300 psi.
5—9000 gal., 8' x 23', dished.
54—5200 gal., 6' x 24', dished, 60 psi.
3—3300 gal., 6' x 15-6", dished, ASME 125 psi.

ACID EQUIPMENT

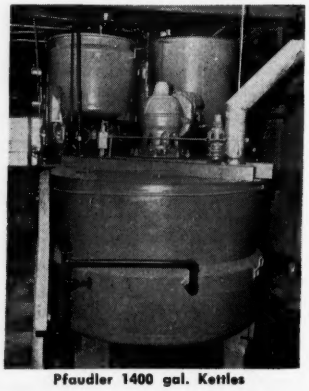
4—Cottrell carbon-tube electric-mist precipitators, (88)-tubes, lead-lined shell.
8—Graver concentrating drums, 10' dia. x 23' long, lead-lined, with furnaces.
8—5500 gal. gas-cooling tanks, lead-lined.
25—Acid-cooling tanks, lead-lined.
16—Duriron denitrating concentrators, 24" dia.x15' high, packed w/Amorphous Quartz.
4—Duriron 24" dia. x 4' high vac. denitrators.

FILTER-TANKS

54—24 sq. ft. Pfaudler 475 gal. St. St. filter tanks, 66" x 30", filter plate.
27—28 sq. ft. Pfaudler St. St. filter tanks.

KETTLES—REACTORS

72—1400 gal. Pfaudler blue glass-lined jacketed kettles, 84" dia. x 54" high, open top, Stainless Steel cover, 3 HP Agit., Adj. baffle.
18—1250 gal. Pfaudler blue glass-lined jkt. reactors (Sulphonators), 72" dia. x 72" high, closed, 3 HP Agit.
54—600 gal. Pfaudler Stainless Steel ammoniating & crystallizing jkt. kettles, 60" dia. x 46" high, open top, Fume hood.
72—250 gal. Pfaudler blue glass-lined jacketed kettles, 42" dia. x 36" high, open top, Stainless Steel cover.



Pfaudler 1400 gal. Kettles

COLUMNS—HEAT EXCHANGERS

16—24" dia. x 15' high Duriron packed columns.
1—24" dia. x 33' high Duriron & St. St. packed column.
4—24" dia. x 4' high Duriron vacuum denitrating columns.
6—1450 sq. ft. T347SS gas condensers, 3-pass Vert. units, inner & outer tubes.
3—1000 sq. ft. Duriron cascade-type pipe coolers.
3—564 sq. ft. Stainless Steel burner-Preheaters, gas condensers, 3-pass.
2—435 sq. ft. Amer. spiral steel exchangers.
9—400 sq. ft. Stainless Steel open-pipe coolers, 2⅜" OD pipe.
12—Amer. spiral heat exchangers T316L S/S: 162, 72 sq. ft.
48—Duriron pipe coolers, 159, 130, 125, 99, 54, 44, 42, 10 sq. ft.
3—18 sq. ft. Ammonia evaporators.

COMPRESSORS—BLOWERS

3—Worthington 3500 CFM air comp., 24 x 15, type LTC-4, 500 HP gas driven.
1—Chicago-Pneu. 3026 CFM air comp., size #19-32-30-18 x 24, horiz. steam driven.
8—Elliott turbo-blowers, 11,620 CFM, type 0, 15.9 psi discharge, 125 HP.
18—Ing.-Rand 6 x 6 x 5 air comp., V-type, 2 cyl, #67D9, type 30, 10 HP.
3—Frick 4 x 4 Ammonia comp., type HB.
2—Worthington 5½ x 3⅛ x 3½ air comp., V-type, 7½ HP.

CENTRIFUGAL PUMPS

20—Worthington 3" x 2", Worthite, #2CG2B, 75 GPM @ 139' 15 HP.
18—Worthington 2" x 1½", Worthite, #1½CG1A, 5 HP.
81—Worthington 2" x 1½", Worthite, #1½CG1A, 3 HP.
30—Worthington 2" x 1½", Worthite, #1½CG1.
27—LaBour 2" x 1½", T316SS, size #15, type DPI, self-priming, 3 HP.
3—Worthington 1½" x 1", Worthite.
8—Ing.-Rand 10" x 8", Iron, size #8AFV, 1800 GPM.
50—Misc. Iron cent. & gear pumps.

BOILERS

3—3000 CFM Edgemoor waste-heat boilers, 250 psi, 535 sq. ft., ASME.
5—435 HP Comb. Eng. water-tube boilers, 300 psi, 4620 sq. ft., 34,500 lb. steam/hr. @ 225% of rating, gas or oil fired.

MISCELLANEOUS

3—Alloy Fab. gas mixer-filters, (3) compartments, Stainless Steel contact parts.
30,000'—Stainless Steel pipe; 6", 4", 3", 2", 1½", etc.
10,000'—Stainless Steel vapor pipe; 12", 16", etc.
10,000—Valves, Stainless Steel, all sizes.
18—Screens, Stainless, 33"x53", single deck.
18—Toledo platform dial scales, 200#.

SEND FOR DETAILED CIRCULAR

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Phone POplar 3-3505

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CIRCLE S ON READER SERVICE CARD

ANOTHER PERRY

LIQUIDATION

AMMONIUM SULPHATE PLANT

EL DORADO, ARKANSAS

3—20,000 gal. T316LC SS crystallizing tanks, 14′ x 15′, plus 11′ cone bottom, 4′ cone top, ⅜″.

1—3250 gal. T316LC SS tank, 6′ x 15′10″.

1—2250 gal. T316LC SS tank, 8′ x 6′ x 3/16″.

1—Link-Belt #900-30 Roto-Louvre dryer, 9′ x 30′, heater, feeder.

3—Worthington 4″ x 3″ Worthite cent. pumps, #3CG-1, 7½ HP.

1—Link-Belt 76″ dia. x 14′ long rotary mixer or cooler.

1—New York Stainless blower, 17,650 cfm.

2—Link-Belt contin. bucket elevators, 40′, 30′ high C/C; neoprene belt.

ALSO—Stainless Steel pipe, valves, duct work, etc.

PERRY FOR PROCESS EQUIPMENT

DRYERS—KILNS

2—Buflovak 42″ x 120″ double drum dryers, ASME 160# WP.
1—American 42″ x 120″ dbl. drum.
1—Buflovak 42″ x 90″ Dbl. drum.
1—Buflovak 32″ x 72″ twin drum dryer, chrome plated drums, St. St. trim.
2—American 36″ x 84″ Dbl. Drum.
1—Buflovak 32″ x 52″ dbl. drum.
1—American 36″ x 84″ double drum dryer, ASME, VACUUM.
1—Buflovak 5′ x 12′, single drum dryer, Vacuum UNUSED.
5—F. J. Stokes #138J-16, 195 sq. ft. vac. shelf dryers.
1—Nerco-Niro stainless spray dryer.
1—Vulcan 10′ x 11′ x 175′ rotary kiln.
2—10′ x 78′ rot. dryers, ¾″.
2—Davenport 8′ x 60′ rotary, 7/16″ welded burners, fans, etc.
1—7′6″ x 62′ rotary kiln, ½″.
2—Louisville 4′6″ x 25′ rotary steam-tube dryers, welded.
1—Bartlett & Snow 3′ x 15′ rotary dryer, Everdur metal shell.

PRESSES

3—Komarek-Greaves 160,000 psi briquette presses.
4—Davenport dewatering presses; #1A, 2A, 3A.
1—French Oil #2-S extraction press.
1—Stokes #T single-punch tab. pres.
1—Stokes #RD-3 rotary tablet press.
1—HPM 63 ton steeping press, UNUSED.

EVAP.—STILLS
COLUMNS—CONDENSERS

7—4050 sq. ft. calandra type evap., copper tubes, cast iron shell.
1—Mojonnier 2085 sq. ft. triple-effect Stainless Sanitary evaporator.
4—Buflovak double-effect stainless evap. vert. long-tube type: 1025, 840, 710, 588 sq. ft.
1—Stokes 118 sq. ft. T316SS Still.
1—Bartlett & Snow 6′ dia. Stainless jkt. evap.-crystallizing kettle.
1—Vulcan 110″ dia. x 16′ high T316SS bubble-cap column, 10 trays.
2—78″ dia. x 35′ plate copper columns.
1—Vulcan 60″ dia. x 16′ high, T316SS bubble-cap column, 10 trays.
1—36″ dia. x 9′-8″ T316SS double col.
6—30″ x 19′ T347 SS packed columns.
15—Copper bubble-cap columns, 24″ to 54″ dia., to 51′ high.
1—1960 sq. ft. T316SS exchanger, remov. bundle, ASME 75# WP.
1—1450 sq. ft. T316SS condenser.
5—1400 sq. ft. T316SS gas converters.
1—915 sq. ft. T304 SS exchanger.
3—800 sq. ft. T316SS condensers.
1—730 sq. ft. T316SS exchanger.
1—510 sq. ft. T316SS condenser.
30—T316SS condensers & exchangers: 427, 425, 410, 400, 290, 277, 264, 250, 200, 185, 165, 150, 145, 105, 83, 73, 54, 52, 50, 47, 30 sq. ft.
9—185 sq. ft. T304SS U-tube coolers.

MIXERS—MILLS

40—Baker-Perkins #17, 200 gal. sigma-blade, jkt. mixers.
1—Baker-Perkins #16-UUEM, 150 gal. Disp. blade, jkt., 150 Hp, vaulted cover, motorized tilt.
1—Baker-Perkins #15, 100 gal. Disp., T347SS, 25 HP drive.
1—Baker-Perkins #15-UUMM, 100 gal., Disp. blade, ASME jkt., 100 HP, Comp. Cover, motorized tilt.
1—J. H. Day #6, 100 gal., St. St. sigma.
2—J. H. Day #5, 75 gal., sigma.
1—Raymond 66″, 6-roller mill, 200 HP.
1—Raymond 50″, 5-roller hi-side mill.
13—Abbe 6′ x 8′ patch pebble mills.
2—Hardinge 7′ x 36″ conical mills.
1—Gemco 60 cu. ft. T304SS conical blender.
1—Bonnot 5′ x 10′ ball mill.

KETTLES—REACTORS

1—2000 gal. Glascote blue G/L reactor, ASME 50 psi or vac. int., 90 psi jkt.
1—1800 gal. T316SS reactor, vacuum internal, new jacket, Agit.
3—1350 gal. T347SS Kettles, open top, paddle agitators.
1—1000 gal. Dopp cast iron Kettle, 125# jacket, 15# int., Agit.
1—750 gal. Graver T304SS jkt. fermenter, ASME 30# int., 30# jkt., 10 HP Turbine Agit.
2—600 gal. T304SS reactors, Jkt., Agit.
2—500 gal. T304SS reactors, jacketed, ASME, Vacuum—Unused.
6—465 gal. T304LSS reactors, jacketed, 150# int., 175# Jkt.
1—300 gal. Pfaudler blue G/L reactor, Agit., Jkt., ASME.
1—300 gal. Glascote blue G/L reactor.
1—200 gal. T304SS jkt. reactor.

FILTERS—CENTRIFUGALS

6—Shriver 48″ C.I. P&F filter presses, 1000 sq. ft., closed delivery.
6—Valley 36″ aluminum P&F filter presses, 65 ch., closed delivery.
5—Sweetland #12 filters, (72) stainless.
1—Niagara #510-28, T316SS filter.
1—Oliver 5′3″ x 8′ recoat rotary vacuum filter, UNUSED.
2—Oliver 5′3″ x 3′ precoat rot. vac. filter, T316SS, ASME 30# WP.
1—48″ Tolhurst susp. cent., T304SS.
5—40″ A.T.&M. susp. cent., T304SS.
2—32″ A.T.&M. susp. cent., T304SS.
1—12″ A.T.&M. susp. cent., 1304SS.
26—Sharples #AS-16V super cent., Inconel, vapor-tite, sludge-disch. frame.
2—Sharples #16-P super cent., T304SS.
2—Sharples #C-20 Super-D-Hydrators.
1—Bird 24″ x 38″ cylin. Steel.
2—Bird 24″ x 38″, T304SS, cylind.
3—Bird 24″ x 24″ Slotted, Monel.
1—DeLaval #AC-VO, nozzlematic.

STAINLESS STEEL TANKS

300—STAINLESS STEEL TANKS IN STOCK—Sizes up to 13,000 gal.—T304, 316, 321, 347, etc.—many with Coil & Agitators.

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CIRCLE T ON READER SERVICE CARD

2 CHEMICAL PLANT SALES

Niagara Falls, N. Y.; Everett, Mass.

STAINLESS COLUMNS

78"x18'x1/4" Vulcan 318 S.S. Bubblecap, 14 trays, 180 caps/tray, 50 PSI.
72"x30'x1/8" Budd 347 SS Bubblecap, 21 trays, 38 caps/tray.
48"x41'x5/16" Vulcan 316 SS Bubblecap, 40 trays, 70 caps/tray, 100 PSI.
36"x21'x1/4" 316 ELC SS Packed, 15 PSI.
36"x20'x3/16" 316 SS Packed, 100 PSI.
14"x17'6"x1/8" 316 SS Packed.
12"x18'8"x3/16" 347 SS Packed, 100 PSI.

COLUMNS

20"x27' GLASS LINED 50 PSI full vacuum.
16"x21' GLASS LINED Scrubber
16"x10' GLASS LINED 25 PSI full vacuum.
84"x25'x3/8" Steel 8 Bubblecap trays.
60"x68'x5/16" Steel 35 Bubblecap trays.
36"x58'x5/16" Steel 35 trays with Reboilers.

REACTORS

Pfaudler 500 gal. ELL. GI. Lined Jktd. Agit.
Dopp 1000 & 1700 gal. Ni-Resist Jktd. Agit.
Vulcan 1000 gal. Everdur Coiled, Agit.
Patterson 1000 gal. Steel Jacketed.
Buflovak 900 gal. Stainless Agit. Elec. Heat.
Patterson 500 gal. Steel Jktd. Agit. 2 HP XP.
Alloy Tanks 300 & 750 gal. SS Press. Stills.

STAINLESS HEAT EXCHANGERS

2320 Sq.ft. 33"x21'-1"x16ga.x16' Tubes.
1000 Sq.ft. 27"x168"-3/4"x16ga.x14' Tubes.
890 Sq.ft. 22"x20'8"-5/8"x16ga.14' Tubes.
800 Sq.ft. 23"x17'10"-3/4"x16ga.x16' Tubes.
615 Sq.ft. 22"x15'9"-5/8"x16ga.x10' Tubes.
420 Sq.ft. 18"x9'6"-3/4"x18ga.x8' Tubes.
300 Sq.ft. 14"x19'6"-3/4"x18ga.x12' Tubes.
235 Sq.ft. 16"x8'3"-5/8"x16ga.x7' Tubes.
188 Sq.ft. 11"x16'8"x5/8"x14ga.x12' Tubes.
146 Sq.ft. 11"x14'x5/8"x16ga.x9'6" Tubes.
68 Sq.ft. 8"x17'3"-3/4"x16ga.x16' Tubes.

CENTRIFUGES—FILTERS

Sharples C-27 Super-D-Hydrator Stainless.
Sharples C-20 Super-D-Hydrator Stainless.
30" Susp. Centrifuge-Imperforate Stainless.
Sharples #6 Super Centrifuge SS Bowl.
5'3"x3' Oliver Precoat Rot. Vac. Filter SS.
4'x1' Bird Young Rot. Vac. Filter Stainless.
36"x24" Goslin Rot. Vac. Filter Stainless.
18"x28" Bird Continuous Stainless.
400 sq.ft. U.S. Auto-Jet Filter Monel Screens

COMPRESSORS—VACUUM PUMPS

Nash #9 Compressors 2150 CFM @ 16 PSI.
Worthington YO 1360CFM @ 35PSI; 150 HP.
Norwalk Hydrogen Comp 5 CFM 15000 PSI.
Nash #4 Vacuum Pump 650 CFM @ 15".

STAINLESS STEEL TANKS

11500 gal. 12'x15'x3/16 agitated.
4500 gal. 6'x25'x1/4" dish/cone 25 PSI coil
4000 gal. 8'x12'x3/16" dished Coiled.
3500 gal. 8'x9'x5/16" dished heads.
1500 gal. 6'x6'9"x1/4" dished heads.
1200 gal. 5'x8'x1/4" Agitated.
750 gal. 4'6"x6'x1/4" dished 42 PSI.
500 gal. 4'x5'x5/16" dished heads.
500 gal. 4'x5'6"x1/4" flat Agitated.
(20) Tanks 50 to 400 gal. some agitated.

SPECIAL ITEMS

TRIPLEX PUMP—2 1/4x4 Stainless 2000 PSI.
CRYSTALLIZER Squire 40"x30" Agit. Jktd.
CRYSTALLIZER Buflovak 6' Vac. Jkt. Agit.
CRYSTALLIZER Swenson 24"x20' Jktd. SS
AIR DEHYDRATOR-Anders 8FA Automatic.
ABSORPTIVE DRYER-Kemp FE02-S.
SIFTERS 30"x96"; 40"x84"; 60"x84" SS
SIFTER 48" Sweco Triple Deck Model A9062
CONVERTER-St. Wells 10'x29' 10000 sq. ft.
HEATER 150KW Hot Oil Hynes Elec. Co.
MIXER 300 gal. B.P. Stainless Sig. 18 DIM.
BLENDER Conical 6' Paterson 69CF 10 HP.
BLENDER Conical 12' 500CF SS clad.
EVAPORATOR-435 Sq. ft. Single Effect.
CENTRIFUGAL PUMPS-STAINLESS-1" to 3" 10 to 750 GPM 35 to 100' Head

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CIRCLE U ON READER SERVICE CARD

Baker Perk. 15 HP. Masticator Mixer.
Hersey 5'x26' Rotary, 316 Stainless.
Day Hy—R Speed Mill 20 HP Expl. Pr.
Buffalo 32"x90" Double Drum Dryer.
Centrifugals: 12", 30", 40" & 48".
Centrifuges: Sharples #5 & #6 Stainless.
Dryers:
Buffalo Vac. Drum Dryer, 24"x20".
Gehnrich Elec. Htd. Dryer 7'x3'x6'.
Despatch Ovens Elec. Heated & others.
3—Devine & Stokes Vac. Shelf Dryers.
Filters: #2 Sweetland 12 Stainless Leaves.
Oliver Rot. Vac. 3'x1'.
Hercules Leaf Filter 36" diam.
Filter Presses: 6" to 36" Iron & Wood.
Kettles, Tanks: S.S. Jack 20 to 1000 gal.
Dopp 350 gal. cast iron Jack. Vacuum.
Devine Impreg. Units 30" to 36" dia.
Mills: Raymond #00, 3 HP, & #0000.
Mikro Pulverizers #4, 2, 1, & Bantam.
Hammer Mills & Pulverizers 3 to 50 HP.
Taylor-Stiles 7 1/2 HP, Cutter.
Rotary Cutters 1 1/2 to 5 HP & up.
Spr. Waldron Stainless spike crusher.
Pebble, Jar & Ball Mills, Lab. to 6' x 8', 3 Roll, 9" x 32", 12" x 30", 16" x 40".
Lehman 4 Roll W.C. 12' x 36" Steel.
Colloid Mills 1 1/2 H.P. & up.
Mixers: BP & Day 75, 100 & 150 gal.
Change Can Mixers 8, 15, 40, 150 gal.
Sprout-Wald., 10,000# horiz. Spiral Mixer.
Day Jumbo 700 gal. horiz. mixer.
Spiral Mixers, 3000, 1000# etc.
Lancaster 6' dia. 25 HP. & #1, 3 HP.
Pumps: Stokes etc. Vac. 10 to 500 CFM.
Gould 75 HP, Centrifugal 250 PSI.
Sifters: Day, Robinson, Rotex type.
Tablet Machines: Stokes R. Colton 4 1/2 T, single punch, Stokes RDI Rotary.
Hydr. Presses, Plastic & Rubber Machy.
Partial Listings. Write For Bulletins

STEIN EQUIPT. CO.

107-8th St., Brooklyn 15, N. Y. Sterling 8-1944

CIRCLE V ON READER SERVICE CARD

IMMEDIATE DELIVERY

Dryers: Buffalovac 3 x 6, all iron; Stokes vacuum dryer-mixer Model 59B; Stokes 4 x 9, 2 roll.
Filters: Sparkler Mod. 33-D-12, Mod. 14-4, Mod. 3326 R; Shriver 12"; Johnson 12".
Kettles: New Groen 20-40-60 Gal. S/S clad w/ cover, pop and draw valves; Groen 40 & 60 Gal. S/S on pedestal bases; Groen 80 gal. S/S 2/3 jacketed for 40 psi w/ cover pop & draw valves; (4) 300 Gal. S/S varnish kettles w/ dolly.
Mills & Pulv.: Fitz. Mod. d-6; Morehouse high R; Gruendler Supermaster No. 1; Prater blue streak; Patterson & Paul O Abbe pebble mills.
Mixers: J. H. Day, 36 cu. ft. mild steel; W & P 100 gal. sigma blade; Baker Perkins 300 gal. size NIM.
Presses: (6) Stokes 150 ton hydraulic & toggle Model 250; Watson Stillman 150 ton; Colton 3RP & 4 1/2T; Stokes rotary Mod. DDS-2.
Reactors: Pfaudler, all glass lined, ASME coded & jacketed—100 gal., 300 gal., 500 gal.

AARON EQUIPMENT CO.

9370 Byron Street
Schiller Park, Illinois
678-1500

CIRCLE W ON READER SERVICE CARD

STRETCH YOUR $$$$

STAINLESS SIGMA MIXER

Baker-Perkins Size 14 working capacity 50 gallons. Heavy cored sigma blades, code jacket for 125 PSI. Vacuum cover. Gear-head motor drive. New 1956. Excellent condition. Stainless construction throughout.

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Screener 2 Deck S.S., also steel
S.S. Jacketed—Blender—Double Ribbon —240 cu. ft.—total
Reactors 500 gal—750 gal steel
Baker Perkins—100 gal—50 HP, S.S. 2 arm jacketed-vacuum hdr. tilt
Aluminum Evaporator Calandria type—never used—1300 sq ft. tube area
Hydraulic Pumps & motors.

MACHINECRAFT CORPORATION
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- Fillers
- Labelers
- Filter presses
- Roller mills
- Mixers
- Pulverizers
- Grinders
- Dryers
- Sifters
- Cappers
- Tablet machines

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Classified Advertising Div.

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GELB

CHEMICAL PROCESS EQUIPMENT

2—J. P. Devine stainless steel jacketed conical vacuum blenders, 30 cu. ft.
1—Pfaudler 750 gal. glass lined jacketed vacuum receiver.
1—Pfaudler glass lined thimble condenser, 62 sq. ft.
1—Glascote Series HR 1000 gal. glass lined jacketed reactor, complete with impeller type agitator, baffle and drive.

AUTOCLAVES, KETTLES, REACTORS

1—2000 gal. stainless steel jacketed reactor.
1—Pfaudler 750 gal. glass lined jacketed reactor.
2—Pfaudler Series EM 300 gal. glass lined jacketed reactors.
1—300 gal. Hastelloy "B" jacketed pressure reactor.
1—Blaw Knox 300 gal. stainless steel vacuum reactor.
2—Theo. Walters Hastelloy "B" 300 gal. jacketed reactors.
4—Pfaudler Series P glass lined jacketed reactors, complete with agitators and drives, 5, 20 and 30 gal.
2—Blaw Knox steel autoclaves, 600 gal.
1—Alloy Fabricators steel jacketed autoclave, 600 gal.
1—125 gal. stainless steel jacketed autoclave with impeller type agitator and drive, 125 psi jacket, 75 psi internal.
1—Van Alst 300 gal. stainless steel jacketed kettle.

CENTRIFUGES

5—Western States type 316 stainless steel 40" suspended type centrifuges complete with perforate baskets, plows and motors.
1—Fletcher 48" stainless steel underdriven centrifuge, complete.
1—AT&M 26" type 316 stainless steel suspended type centrifuge, complete.
5—Tolhurst 40" and 30" rubber covered centrifuges.
1—Sharples type 316 stainless steel Super-D-Canter, PN-14, complete.
1—Sharples type 316 stainless steel centrifuge, Model D-2.
1—Sharples Model C-27 Super-D-Hydrator.

DRYERS

2—Louisville 8' x 50' stainless steel rotary dryers.
1—Stokes double drum dryer, 5' x 12'.
1—Buflovak 24" x 36" chrome plated double drum dryer.
1—Allis Chalmers stainless steel rotary dryer, 6' x 50'.
10—Allis Chalmers rotary dryers, 6' x 50' and 7' x 60'.
1—Buflovak stainless steel jacketed rotary vacuum dryer, 5' x 30'.
1—Link Belt steel roto louvre dryer, Model 207-10.
1—Link Belt steel roto louvre dryer, Model 502-20.
1—American 42" x 120" double drum dryer, ASME, complete.
1—Buflovak steel jacketed rotary dryer, 3' x 15'.
2—Stainless steel pilot plant spray dryers.

FILTERS

2—Oliver stainless steel rotary filters, 3' x 2' and 3' x 4'.
12—Sweetland #12 pressure leaf filters with 72 stainless steel leaves.
1—Niagara stainless steel filter, Model 510-28.
1—Sperry 36" x 36" heresite covered filter press, 40 chambers.
10—Shriver plate and frame filter presses, 12" to 42".

THE GELB GIRL — AUGUST 1961

MIXERS

1—Abbe 10 gal. steel double arm sigma blade jacketed mixer.
1—J. H. Day 200 gal. stainless steel double arm sigma blade jacketed mixer.
3—Sprout Waldron 30 cu. ft. steel jacketed double ribbon blenders.
1—Gemco stainless steel double cone jacketed blender, 69 cu. ft.
1—Stokes stainless steel granulator, Model 43B.
1—Sturtevant #7 Dustite rotary batch blender, NEW.
15—Robinson type 304 stainless steel horizontal blenders, 255 cu. ft.
1—Robinson type 304 stainless steel horizontal blender, 125 cu. ft.
1—Baker Perkins 150 gal. dispersion mixer, complete.
1—J. H. Day 5 gal. double arm sigma blade mixer, stainless steel.
1—Stokes stainless steel granulating mixer, Model 21-J.
1—Patterson-Kelley stainless steel twin shell blender, 2 cu. ft.

MISCELLANEOUS

1—Cleaver Brooks 500 HP package steam generator, 200#.
1—Cleaver Brooks 150 HP package steam generator, 150 psi.
1—Superior 300 HP package steam generator, 125 psi.
1—Sprout Waldron pelletizer, Type 501FF.
1—Williams "Comet" 4 roll mill, complete.
1—Raymond 2 roll high side mill.
1—6" x 14" Ross 3 roll paint mill, high speed, complete.
1—Vulcan stainless steel bubble cap column, 4' dia. x 25 plates.
1—Griscom Russell stainless steel heat exchanger, 900 sq. ft.
3—Badger stainless steel heat exchangers, 500 sq. ft. and 600 sq. ft.
4—Patterson stainless steel condensers, 200 and 300 sq. ft.
20—Davis Engineering stainless steel heat exchangers, 102, 119, 136, 166 sq. ft. NEW.
2—Mikro Bantam pulverizers.
1—Mikro #3TH stainless steel pulverizer, complete.
3—Pfaudler glass lined thimble type condensers, 9 and 14 sq. ft.
1—Struthers Wells stainless steel 1150 sq. ft. single effect evaporator.

2—Stainless steel 2000 gal. horizontal storage tanks.
1—Patterson-Kelley stainless steel jacketed 1000 gal. reactor.
1—10,000 gal. horizontal rubber lined storage tank.
1—Tolhurst Type 316 stainless steel 48" Batch-O-Matic centrifuge, NEW.

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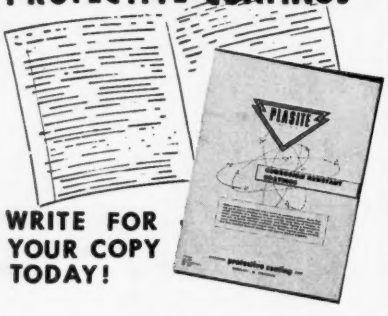

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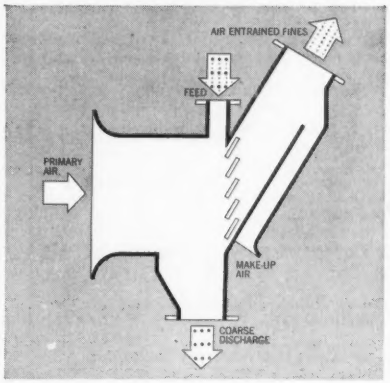

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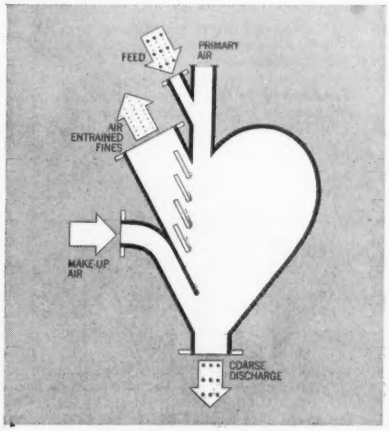

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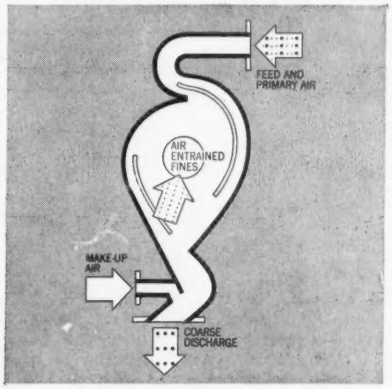

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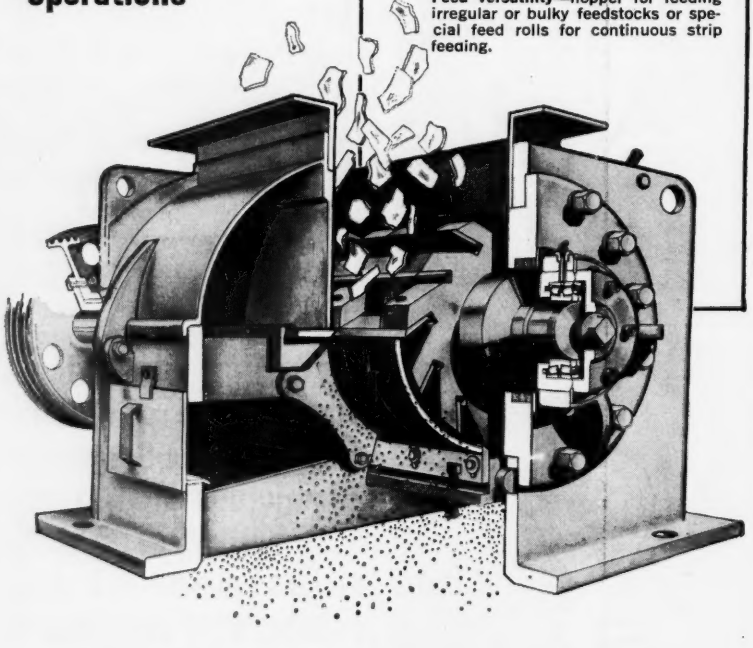

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